Effect of introduction of German and Hungarian bank levies on banks' risk-taking behavior

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ABSTRACT

Policymakers introduce bank levies (BLs) to reduce the probability of crises. In this study, we evaluate the effects of the Hungarian and German BLs implemented in 2010 and 2011, respectively, on the banks' risk-taking behavior. Our analysis compares two completely different BL designs. The German BL is designed to increase as banks' total liabilities increase, while the Hungarian BL is assessed on total assets. The results unambiguously demonstrate that a BL on assets increases banks' credit risk. The results of analyzing the influence that introducing BLs has had on the German banking sector demonstrate that BL on liabilities decreases banks' credit risk. An improved understanding of the impact of regulation on the risky activity of EU banks is very important for a wide range of financial market participants, including borrowers, shareholders regulators and supervisors, especially during turbulent times caused by the COVID-19 pandemic and the Russian war in Ukraine.

JEL Classification: G010, G2, G28

Keywords: bank levy, credit quality, banks, regulations, taxation.

1. INTRODUCTION

The question regarding the additional taxes on banks gained prominence following the financial crisis of 2007–2008. The topic has generated extensive public and political discussion in recent years with many proposals presented, some of which have been implemented in national legislation. In 2010, the International Monetary Fund (IMF, 2010) proposed the Financial Stability Contribution of the financial sector, within which the main component was intended to be a levy to pay for the fiscal cost of any future government support to the sector. IMF stated that this contribution might be paid by all financial institutions and reflect individual institutions' riskiness and contributions to systemic risk.

One of the main purposes of introducing a bank levy (BL) was to limit bank involvement in risky activities and to minimize the likelihood of potential systemic crises, such as those experienced in 2007–2008 (Cannas et al., 2014). Thus, many countries decided to introduce this

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regulatory instrument, even though the taxation schemes they applied differed. For example, the European Union Member States, such as Austria, Belgium, Cyprus, Denmark, Germany, the Netherlands, Latvia, Portugal, Romania, Slovakia, Sweden, and the United Kingdom, decided to introduce a BL on bank liabilities, while Poland and Hungary proposed a BL on bank assets. In turn, France chose to levy bank capital.

The main goal of the study is to examine whether the BLs introduced in Germany and Hungary are fulfilling their roles. In this research, we evaluate the effects of the Hungarian and German BLs implemented in 2010 and 2011, respectively, on the risk-taking behavior of banks. 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 according to the total net assets of inter-bank lending (Devereux, Johannesen, & Vella, 2015).

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

The estimation results demonstrate that the BL on assets increases banks' risk-taking activities. The BL introduction in Hungary increases the bank's average LLP, especially in smaller commercial banks and other entities. Moreover, research shows that the amount of paid BL also matters. Moreover, BL introduction in Hungary also increases a bank's ROE-volatility ratio. The results suggest that commercial banks with total assets below 50 billion forints are most acutely affected. The estimation results demonstrate that the BL on liabilities decreases banks' risk-taking activities. BL introduction in Germany decreases a bank's LLP, especially in commercial banks with contribution-relevant liabilities lower than EUR 10 billion. However, BL introduction in Germany is found to decrease a bank's ROE volatility ratio in commercial banks.

The main contribution of this study is to answer the question of whether the BL introduced in Europe is fulfilling its expected role. The results of the study indicate that the answer depends on its construction, as the solution introduced in Germany actually reduced the risks taken by banks. However, the Hungarian solution had the opposite effect. Therefore, the results of the research are relevant from the regulators' perspective, especially among those who are currently planning to modify the design of the BL. In particular, the findings are important from the point of view of countries where, as in the Hungarian model, BL depends on the banks' assets. Additionally, 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. Moreover, the literature shows that little is known about the effect of BLs on institutions' risk-taking behaviors in the cases of two different BL models. Therefore, we argue that this study could significantly contribute to the existing body of knowledge about the BL concept.

The remainder of the paper proceeds as follows: the next section presents the structure of BLs in Europe and reviews the literature in order to develop the hypotheses. The third section presents the study in terms of the sample, and methodology. The fourth section reports the summary statistics, and the fifth section analyses the empirical results. The final section provides conclusions.

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2. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

2.1. The structure of BLs in Europe

A BL is a tax on specific elements of bank 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-banking sector or the growth in lending to the non-banking sector exceed a threshold (Devereux et al., 2015). In Poland, the BL is calculated on total assets. The detailed explanation of all European BL construction is presented in an article written by Puławska (2021a).

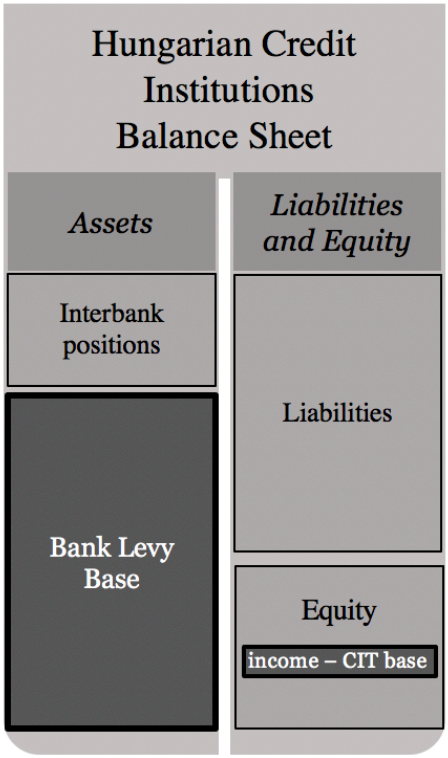
2.1.1. The BL in Hungary

The Hungarian banking sector deserves special consideration, as this country decided to introduce a BL 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 banking 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. In the article, the general term „bank" is used for all entities subject to Hungarian BL. The approach is in line with, among others, Capelle-Blancard and Havrylchyk (2017).

Unlike other countries, Hungary, and later Poland, decided to tax the asset side of banks' balance sheets. The levy applies to all banks, 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

Figure 1
Hungarian Bank Levy



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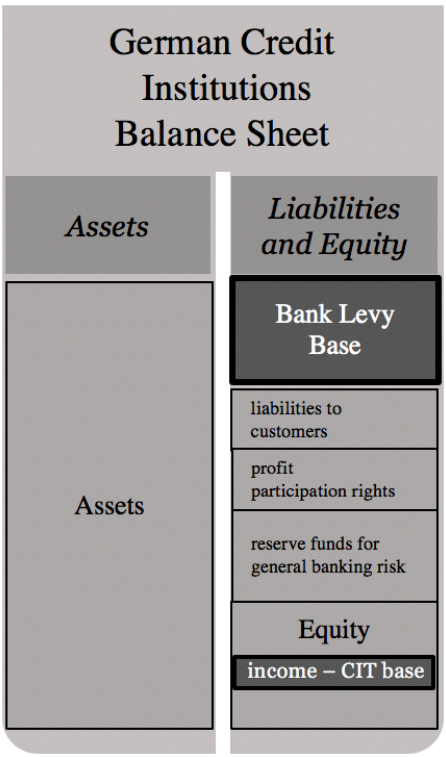
at the amount of assets in 2009. The levy is set at 0.15% of the tax base for small banks (those with assets below 50 billion forints (around EUR 185 million)) and 0.53% of the tax base for larger institutions. This means that the ratio of total tax paid by large banks more than tripled from 0.15% of total assets to 0.53% (Capelle-Blancard & Havrylchyk, 2017). In Figure 1, the Hungarian BL and corporate income tax (CIT) is presented.

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 banks between 2008 and 2013 (EUR 64 billion). The German BL applies to all credit institutions with a German banking license, and it is managed by the Federal Agency for Financial Market Stabilisation (Buch et al., 2016). In the article, the general term "bank" is used for all entities subject to German BL. The approach is in line with, among others, Buch, Hilberg, and Tonzer (2016).

As only systemic banks were rescued there, smaller banks benefit from a tax allowance (Buch et al., 2016), which means that the BL rate for large banks is higher (Buch, Tonzer, & Weigert, 2017). However, Haskamp (2016) observes spill-over effects of the BL from levy-paying banks to banks in the German banking sector that are not obligated to pay the BL. He claims that 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.

Figure 2
German Bank Levy



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 are deducted. 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 bank's 2010 balance sheet. Deposits are exempted, as banks 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. In Figure 2, the German BL and corporate income tax (CIT) were presented.

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2.2. Hypotheses development

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

The main aim of the BL, according to IMF (2010), was to pay for the fiscal cost of any future government support to the financial sector and to decrease individual institutions' riskiness. However, researchers and experts have also noticed that BLs might 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).

Previous research on the BL introduced in Hungary signals its negative impact on the stability of the banking sector. For example, Devereux, Johannesen, and Vella (2019) find that the Hungarian BLs induced banks to borrow less but also to hold more risky assets. The reduction in funding risk clearly dominates for banks with high capital ratios but is exactly offset by the increase in portfolio risk for banks with low capital ratios. This suggests that while the levies have reduced the total risk of relatively safe banks, they have done nothing to curb the risk of relatively risky banks, which presumably pose the greatest threat to financial stability. Moreover, Puławska's (2021) and Hryckiewicz and Puławska's (2022) research showed that commercial banks in Hungary prefer to restructure their balance or shift assets among different locations or entities to decrease the BL. Moreover, BL on assets might significantly decrease the value of some interbank loans (Puławska, 2020).

In this study, we argue that Hungarian banks 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 might cause greater willingness to lend to riskier borrowers and consequently might translate into increased credit risk (Blundell--Wignall, Atkinson, & Roulet, 2018)including those associated with collateralised agreements at the heart of complexity and interdependence problems. They point out that in normal times these risk positions mostly cancel out (one's loss being another's gain. Therefore, we formulate the following hypothesis:

H1: *The introduction of a BL in Hungary increases risky activities as banks 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 banks?

The German government introduced a completely different solution compared to the Hungarian one. Buch et al. (2016) were among the first to examine and provide evidence of the German BL's impact on the banking sector. They find that, compared to unaffected banks, banks affected by the BL reduced loan supply. They also conclude that banks 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 banks affected by BLs significantly decrease their contribution-relevant liabilities. Banks are replacing contribution-relevant liabilities by non-affected funding (equity and customer deposits), which may help affected banks avoid the BL and decrease risky activities. Kogler's (2019) bank-level evidence also shows that the levy indeed increases the lending and the deposit rate as well as the net interest margin.

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However, by raising the cost of borrowed funds, German levies are designed to increase the banking sector's stability by inducing banks to rely more on their own capital (Haskamp, 2018). At the same time, research shows that a levy on secured liabilities can prevent banks from investing in gambling assets if the levy does not depend on the banks' financial performance (Diemer, 2017). Additionally, Chronopoulos, Sobiech, and Wilson (2019) investigated the impact of the BL on liabilities on bank net worth. They find a significant loss of value for affected banks, following the introduction of the levy. This suggests that the burden of the levy is borne partly by the affected bank's shareholders. Celerier et al. (2020) showed that BLs on liabilities, applied to Belgium banks, lead to a decrease of their leverage, suggesting that these taxes can be a complementary tool to capital requirements.

In line with Devereux et al.'s (2015) argument, the first theoretical prediction may be that a levy on banks' 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 banks to rely more on equity funding (Devereux et al., 2013). As in Germany, the BL is on the 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 banks 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 banks during 2005–2015, which means that both pre-BL years and post-BL years (when the German and Hungarian BLs are in place) are considered. Such a wide range of data was taken due to the intention to include the period before the global financial crisis of 2007–2008 and accessibility to uniformly reported data.

Consequently, the sample consists of 2,133 observations (47 Hungarian banks with unconsolidated financial statements and 292 German banks 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. The advantage of using the fixed-effect model is to control for bank unobserved individual characteristics. This allows us to capture the heterogeneity between the banks. This means that bank-specific features have been captured by the bank fixed effect (Wooldridge, 2015). We refer to unconsolidated financial statements for all estimations because we argue that the BL effect should be more evident in unconsolidated than consolidated statements, as conglomerate banks might make some

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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 bank level. Following Petersen (2009), we assume that clustered standard errors are unbiased as they account for the residual dependence created by the bank effect. The clustered standard errors correctly account for the dependence in the data common in panel datasets and produce unbiased estimates. Finally, we add a year dummy to control for any other changes in regulations and existence of many other events that are likely to have affected bank risk-taking.

The regression equation consists of bank controls and country controls. The regression is:

$$RISK_{jt} = \beta_0 + \beta_1 BL_t + \beta_2 Size_{jt} + \beta_{3jt} LoanActivityy_{jt} + \beta_4 Efficiency_{jt} + \beta_5 Loss_{jt} + \beta_6 Liquidity_{jt} + \beta_7 Capital\ ratio_{jt} + \beta_8 Inflation_{jt} + {}_{\beta 6} GDPgrowth_{jt} + \varepsilon_j \quad \text{Eq. (1)}$$

β_0 = Intercept term
β_1 = Coefficient for the variable from a given hypothesis
$\beta_2 - \beta_6$ = Coefficients for the control variables
j = Firm's identifier
t = Time as year
ε_{jt} = Error term

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 portfolio quality, the Z-score ratio as a proxy for individual risk, and, in robustness tests, ROE volatility as a proxy for risky bank 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 are one of the main accrual expenses for banks. They are set aside by bank managers to face a future deterioration of credit portfolio quality (Curcio & Hasan, 2015). Loan loss provision estimate is a credit risk management tool used by banks to mitigate expected losses on bank loan portfolio (Curcio & Hasan, 2015).

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 (Hryckiewicz, 2014; Laeven & Levine, 2009; Altunbas, Binici, & Gambacorta, 2018). This ratio is predictive of the bankruptcy risk to which banks 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 a four-year moving average and defined as the ratio of the sum of a bank's average return on assets and capitalization (total equity/total assets) to the standard deviation of return on assets. 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).[1] A higher Z-score indicates that a financial institution is further from default and, therefore, more stable (Delis & Staikouras, 2011).

[1] The author has used the method proposed also by Yeyati & Micco (2007) and Lepetit & Strobel (2013) to calculate the Z-score. In any of the estimations, the results did not differ in terms of significance. However, following Bongini, Iwanicz-Drozdowska, Smaga, and Witkowski (2018), we agree that there is a lot of weaknesses of aggregated bank-level accounting-based measures as predictors of system-wide bank distress and the use of Z-scores to measure the financial strength of the overall banking system should be reconsidered. Therefore, we concentrate research on LLP.

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Following Devereux et al. (2015), in a robustness check, we use ROE volatility as a proxy for risky bank activities. We measure ROE volatility as the absolute difference between the book value of ROE of the bank itself and the median book value of ROE within the reference group of the bank, with the same size decile and the same equity-asset decile. Increasing ROE volatility increases financial risk (Kwan, 1998). Moreover, higher ROE volatility indicates lower earnings quality (Minami & Wakatsuki, 2014). Following Devereux et al. (2013), we assume that banks that are more willing to take risk should, on average, experience more extreme outcomes. Therefore, assuming that BLs reduce risk, banks exposed to BLs should experience equity returns closer to the reference level of ROE (Devereux et al., 2013). BL is estimated as a dummy variable equal to one for all years when BLs exist and zero otherwise.

In addition, we include a large set of control variables to ensure the BL effect is not influenced by other bank or country characteristics. The construction of all variables is explained in Table 1.

Table 1
Explanation and construction of all variables used

Label	Explanation	Measurement
	Dependent Variables	
Z-score	This ratio predicts the bankruptcy of institutions (Altman et al., 2013).	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, banks' 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 banks' risky activities. The increase in ROE volatility increases the financial risk (Kwan, 1998). Moreover, higher volatility of ROE indicates a lower quality of earnings (Minami & Wakatsuki, 2014). Banks that are more willing to take risk should, on average, experience more extreme outcomes. Assuming that levies reduce risk, banks exposed to the levies should experience equity returns closer to the reference level of ROE volatility (Devereux et al., 2013).	The absolute difference between the book value of return on equity of the bank itself and the median book value of return on equity within the reference group of the bank, 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 company j paid BL in year t, then equals 1; otherwise, zero.
BLpaid	Simulated amount of BL payments during each year.	Natural logarithm of amount calculated according to Puławska (2021a).

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Table 1 – continued

Label	Explanation	Measurement
Loan activity	This ratio measures a bank's activity. This greater relative proportion of loans in the portfolio of the banks is usually coupled with a greater liquidity risk arising from the banks' 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	Bank 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 banks 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 banks tend to be more willing to take risk due to the moral hazard problem (De Jonghe, 2010; Uhde & Heimeshoff, 2009).	Natural logarithm of total assets.
Efficiency	Existing research confirms that less efficient banks are more willing to take on additional risk (Louzis, Vouldis, & Metaxas, 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 company j has a loss in year t, then equals 1; otherwise, zero.
Liquidity	We use the liquidity ratio defined as the ability of a bank to fund increases in assets and meet obligations as they become due, without incurring unacceptable losses. Research shows that more liquid banks behave less risky (Kashyap, Rajan, & Stein, 2002)	Current assets to total assets.
Capital ratio	Capital ratio measures the bank's financial strength and should have an effect on the risk-taking behavior of the bank (Tran, Lin, & Nguyen, 2016).	Equity to total assets ratio.
Inflation	Inflation creates pressure for banks to modify their behavior in competing for funds and make banks more keenly aware of higher interest rates on money market instruments (Arpa, Giulini, Ittner, & Pauer, 2001).	Value of inflation in a given year.

4. SUMMARY STATISTICS

Table 2 presents summary statistics of the unconsolidated financial statements of Hungarian and German banks for the entire sample period (2005–2015). Table 3 presents summary statistics of the unconsolidated financial statements of Hungarian and German banks before the BL implementation (Hungary in 2005–2009 and Germany in 2005–2010), while Table 4 presents summary statistics on unconsolidated financial statements of Hungarian and German banks after the BL implementation (Hungary in 2010–2015 and Germany in 2011–2015).

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Table 2
Summary statistics on unconsolidated financial statement of Hungarian and German banks for the entire sample period (2005–2015)

	Hungarian banks					German banks				
VARIABLES	**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	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	1.260	2.690	-7.666	14.987	1,725	3.753	12.706	-2.000	67.000
ROE (%)	242	9.290	23.540	-133.333	80.928	1,725	4.037	7.457	-93.722	99.000

Table 3
Summary statistics on unconsolidated financial statement of Hungarian and German banks before the implementation of the BL (Hungary in 2005–2009 and Germany in 2005–2010)

	Hungarian banks					German banks				
VARIABLES	**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	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	1.000
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

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Table 4
Summary statistics on unconsolidated financial statements of Hungarian and German banks after BL was implemented (Hungary in 2010–2015 and Germany in 2011–2015)

	Hungarian banks					German banks				
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
Loan activity (%)	187	53.200	25.200	2.240	98.600	701	56.500	22.200	0.000	98.900
Total Asset	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

Tables 3 and 4 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 3 and 4 suggest that the Z-score ratio increased in the Hungarian banking sector and decreased in German banks after the BLs were introduced. However, the LLP in German banks decreased after the BL introduction, which may mean that banks reduced their high-risk lending practices; we observe a similar trend in Hungary. ROE volatility increased in the Hungarian banking sector and decreased in German banks after the BLs were introduced.

5. RESULTS

5.1. Does the Hungarian BL increase the risk-taking behavior of banks?

Table 5 presents the regression results for the entire sample, that is, including banks operating within the Hungarian financial system, as well as the results for commercial banks only. In this research, 67% of the analyzed Hungarian banks are commercial banks.

The estimation results demonstrate that the BL on assets increases banks' risky activities. According to Table 5, the BL introduction increases the bank's average LLP by 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 lower credit quality in Hungarian banks, which confirms the first hypothesis. However, this result is only significant when the entire sample is considered; the results seem to suggest that the total sample of commercial banks is not affected. Commercial banks also differ from other banks in terms of their business objectives, regulation, and ownership structures (Beck, Demirgüç-Kunt, & Pería,

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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).

Table 5
Data presenting estimations based on a fixed effects estimator regarding Hungarian banks.
Symbols *, **, *** represent statistical significance at the level of 10%, 5%, and 1%, respectively.

	All banks		Commercial banks	
VARIABLES	**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
Institution FE	YES	YES	YES	YES

As mentioned, the Hungarian tax authority decided to vary levy rates depending on bank size. Banks whose total assets exceed 50 billion forints (approximately EUR 160 million) are heavily taxed at the rate of 0.53%, whereas other banks 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 6 presents the results.

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Table 6
Data presenting estimations based on a fixed effects estimator regarding Hungarian commercial banks. Symbols *, **, *** represent statistical significance at the level of 10%, 5%, and 1%, respectively.

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

According to Table 6, in smaller commercial banks, LLPs have doubled after BL introduction. 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 banks in Hungary are taxed at different rates depending on size, we argue that smaller banks 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).

An interesting question is how risk-taking behavior changes after BL introduction in banks that provide services beyond the scope of ordinary commercial banking, that is, banks other than commercial banks. Table 7 presents the regression results for banks other than commercial banks.

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Table 7
Data presenting estimations based on a fixed effects estimator regarding non-commercial banks in Hungary. Symbols *, **, *** represent statistical significance at the level of 10%, 5%, and 1%, respectively.

	Non-commercial banks	
VARIABLES	**LLP**	**Z-score**
BL	1.152**	0.987
	(0.532)	(1.449)
Loan activity	-3.119	-3.498
	(2.527)	(2.901)
Size	0.213	-6.230**
	(0.525)	(2.177)
Efficiency	-1.982**	-0.923
	(0.719)	(0.878)
Loss	0.885*	-2.102*
	(0.496)	(1.180)
Liquidity	-0.452	0.302
	(0.376)	(0.639)
Capital ratio	-1.231	8.838***
	(1.099)	(2.239)
Inflation	0.121	-0.140
	(0.096)	(0.170)
GDPgrowth	-0.026	-0.149
	(0.0576)	(0.117)
Constant	2.679	11.42**
	(11.55)	(4.201)
Observations	48	78
R-squared	0.578	0.743
Institution FE	YES	YES

According to Table 7, BL introduction is found to increase a bank's LLP by 1.152 percentage points. Therefore, the introduction of a BL in Hungary increases risky activities as banks do not have the flexibility to pass on BL costs. Therefore, willingness to lend to riskier borrowers should increase. It confirms the first hypothesis.

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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 banks' risk-taking. Table 8 presents the regression results.

Table 8
Data presenting estimations based on a fixed effects estimator regarding banks in Hungary.
Symbols *, **, *** represent statistical significance at the level of 10%, 5%, and 1%, respectively.

	All banks		Commercial banks	Non-commercial banks
VARIABLES	**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
Institution FE	YES	YES	YES	YES

The estimation results demonstrate that the amount of paid BL on assets influences banks risky activities. According to Table 8, the increase in paid BLs is found to increase bank LLP by 0.0671 percentage points in all banks. This increase is especially seen in non-commercial banks, and the results seem to suggest that commercial banks are not affected.

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5.3. Robustness checks

In this section, we perform several robustness tests to ensure the validity of our results. Table 9 presents the regression results where the LLP and Z-score are replaced by ROE volatility. Therefore, assuming that levies reduce risk-taking behavior, banks exposed to levies should experience equity returns closer to the average level of ROE volatility.

Table 9
Data presenting estimations based on a fixed effects estimator regarding all banks in Hungary.
Symbols *, **, *** represent statistical significance at the level of 10%, 5%, and 1%, respectively.

	ROE-Volatility			
VARIABLES	**All banks**	**Commercial banks**	**Commercial banks with total assets below 50 billion forints**	**Commercial banks with total assets equal to 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	32.29*	-99.89
	(136.8)	(100.5)	(17.96)	(161.8)
Observations	243	165	38	127
R-squared	0.236	0.242	0.493	0.283
Institution FE	YES	YES	YES	YES

According to Table 9, the BL introduction is found to increase a bank's ROE volatility ratio by 5.255 on average in all banks, and these results are statistically significant. The results seem to suggest that commercial banks with total assets below 50 billion forints are most affected, where the ROE volatility ratio increases more than eight times. Our findings support the evidence that BL introduction increases risk-taking by Hungarian banks.

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5.4. Does the German levy discourage banks 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 10 presents the regression results for the entire sample, that is, all banks operating in the German banking system, as well as those of commercial banks only. In this research, 40% of the analyzed German banks are commercial banks.

Table 10
Data presenting estimations based on a fixed effects estimator regarding all German banks.
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.

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

The estimation results demonstrate that the BL on liabilities decreases banks' risky activities. According to Table 10, the BL decreases a bank's LLP by 0.648 percentage points in all banks 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 bank borrowing induces banks to rely more on equity funding. Moreover, Kopecky and VanHoose (2006) find that the imposition of regulatory capital requirements has an initially ambiguous effect on aggregate loan quality,

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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.

Germany introduced a progressive BL in the wake of the financial crisis, with the purpose of financing a restructuring fund. As only systemic banks are rescued, a tax allowance was introduced to relieve smaller banks from the tax burden (Buch et al., 2016). Consequently, large commercial banks and head banks of savings banks and credit unions contributed the most (Buch et al., 2017). The German BL 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 11, we compare the regression results of commercial banks with contribution-relevant liabilities below and equal to EUR 10 billion and those exceeding EUR 10 billion.

Table 11
Data presenting estimations based on a fixed effects estimator regarding German commercial banks. Symbols *, **, *** represent statistical significance at the level of 10%, 5%, and 1%, respectively.

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

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According to Table 11, 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, that 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).

As with the Hungarian sample, we evaluate the risk-taking behavior of entities other than commercial banks, following the BL introduction. Table 12 presents the regression results.

Table 12
Data presenting estimations based on a fixed effects estimator regarding German non-commercial banks. Symbols *, **, *** represent statistical significance at the level of 10%, 5%, and 1%, respectively.

	Banks other than commercial banks	
VARIABLES	**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

According to Table 12, the BL decreases the LLP by 0.564 percentage points. These correlations can be interpreted in the same way as the results of the smaller commercial banks presented in Table 11.

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5.5. 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 EUR 300 million. Table 13 presents the regression results.

Table 13
Data presenting estimations based on a fixed effects estimator regarding all German banks.
Symbols *, **, *** represent statistical significance at the level of 10%, 5%, and 1%, respectively.

	All banks		Commercial bank	Non-commercial banks
VARIABLES	**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

The estimation results demonstrate that an increase of the amount of paid BL on liabilities influences banks' risky activities. According to Table 13, we find that the LLP decreases in non-commercial banks 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 banks and it is significant. It shows that with an increase of the amount of paid BL, the Z-score decreases; therefore, the risk of default increases.

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5.6. 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 that levies reduce risky activities, banks exposed to levies should experience equity returns closer to the reference level of volatility. Table 14 presents the regression results.

Table 14
Data presenting estimations based on a fixed effects estimator regarding all German banks.
Symbols *, **, *** represent statistical significance at the level of 10%, 5%, and 1%, respectively.

	ROE-Volatility			
VARIABLES	**All banks**	**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	13.02	16.39*	22.48
	(13.69)	(8.118)	(9.395)	(21.44)
Observations	1,725	691	638	53
R-squared	0.060	0.062	0.069	0.154
Institution FE	YES	YES	YES	YES

The estimation results demonstrate that the BL on liabilities decreases banks' risky activities. According to Table 14, 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 that 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 banks. Our findings support the evidence that BL introduction decreases risk-taking by German banks.

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6. CONCLUSIONS

Various taxes have been imposed within the banking sector in Europe, one of which is a tax depending on the balance sheet position, i.e., a BL. In this study, we analyzed the impact of BLs on the German and Hungarian banking sectors, and our regression estimations show that the effect of BLs depends on their construction. More specifically, the results demonstrate that the BL on assets introduced in Hungary has increased the LLP. This effect is the most significant for small commercial banks. This could be because 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 take on higher risk to potentially reduce their tax burden.

Within the German banking sector, the estimation results are also consistent with expectations and the extant literature. The LLPs of German banks decrease following the BL introduction. According to our results, banks with lower tax rates have a more significant decrease in the LLP than other banks. Moreover, our research shows that, for commercial banks and those subject to a lower BL, this effect was more evident. A levy is intended to curb banks' risk-taking behavior, and this goal has been achieved in the German banking sector. In Hungary, the effect is entirely the opposite. Accordingly, our research suggests that the asset-based levy should be reformed in order to avoid banks' insolvency. These results are also relevant to regulators in other countries where levies are based on assets, such as Poland.

The comparison of only two BL models should be considered as the main limitation of this research. The German and Hungarian models actually represent opposite models, but for an accurate overview of the impact of BLs, future research might consider a third type of bank tax, which is the model introduced in France.

Therefore, it is suggested that further studies both extend the types of BL models analyzed and consider the changes that regulators have implemented since the BLs were introduced. Previous studies as well as this research indicate that not all BL models fulfill their role. This has been observed by both researchers and regulators who have made changes to BL-related regulations. Have did these changes improve the effectiveness of this regulatory instrument?

Due to the current energy crisis, some countries are introducing, and some intend to introduce, additional taxes on banks. For example, the Spanish government plans to impose a 4.8 percent tax on banks' income from interest and commissions for two years, arguing that rising interest rates earn "extraordinary" profits for the banking and energy sectors in which inflation may further increase profits. On September 23, 2022, the European Central Bank (ECB) received a request from the Banco de España, on behalf of the Spanish Parliament, for an opinion on a draft law. Such a law addressed the imposition of temporary levies on operators in the energy sector, credit institutions, and financial credit establishments, to counter the cost-of-living crisis. However, the ECB warned that Spain's so-called "windfall" tax could negatively impact the profitability of lenders, as the basis on which the temporary levy would be established does not take into consideration the full business cycle and does not include, *inter alia*, operational expenses and the cost of credit risk. As a result, the amount of the temporary levy might not be commensurate with the profitability of a credit institution. Thus, as a result of the general application of the temporary levy, credit institutions that do not necessarily benefit from current market conditions could become less able to absorb the potential downside risks of an economic downturn. The ECB also suggested that Spain's proposal could distort market competition both within Spain and across the banking union (ECB, 2022). However, countries including Italy, Hungary, and the Czech Republic have also already announced plans of imposing extra taxes on banks to reduce the impact of energy prices (ECB, 2022).

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However, upon analysis of the results of this study, which directly show that an inadequate tax model can have a negative impact on the banking sector, we agree with the ECB's view that:

> *"Imposing any ad hoc taxes or levies on credit institutions for general budgetary purposes should be preceded by a thorough analysis of potential negative consequences for the banking sector to ensure that such taxes do not pose risks to financial stability, banking sector resilience and to the provision of credit, which could eventually adversely affect real economic growth*" (ECB, 2022, p. 4).

References

Albertazzi, U., & Gambacorta, L. (2010). Bank profitability and taxation. *Journal of Banking & Finance*, *34*(11), 2801–2810. https://doi.org/10.1016/j.jbankfin.2010.06.003

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. https://doi.org/10.1016/j.jimonfin.2017.11.012

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., & Pería, 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. https://doi.org/10.1007/s10693-010-0085-4

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. https://doi.org/10.1016/j.jfineco.2004.06.003

Blundell-Wignall, A., Atkinson, P., & Roulet, C. (2018). The determinants of the riskiness of banks. In A. Blundell-Wignall, P. Atkinson, & C. Roulet (Eds.), Globalisation and finance at the crossroads: The financial crisis, regulatory reform and the future of banking (pp. 157–173). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-72676-2_6

Bongini, P., Iwanicz-Drozdowska, M., Smaga, P., & Witkowski, B. (2018). In search of a measure of banking sector distress: Empirical study of CESEE banking sectors. *Risk Management*, *20*(3), 242–257. https://doi.org/10.1057/s41283-017-0031-y

Boyd, J. H., & De Nicolo, G. (2005). The theory of bank risk taking and competition revisited. *The Journal of Finance*, *60*(3), 1329–1343. https://doi.org/10.1111/j.1540-6261.2005.00763.x

Buch, C., Tonzer, L., & Weigert, B. (2017, March 6). *Assessing the effects of regulatory bank levies*. Retrieved March 6, 2022, 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

Cannas, G., Cariboni, J., Marchesi, M., Nicodème, G., Giudici, M. P., & Zedda, S. (2014). Financial activities taxes, bank levies and systemic risk. *European Commission Taxation Papers*, *43*. https://doi.org/10.2778/3498

Capelle-Blancard, G., & Havrylchyk, O. (2017). Incidence of bank levy and bank market power. *Review of Finance*, *21*(3), 1023–1046. https://doi.org/10.1093/rof/rfx007

Chronopoulos, D. K., Sobiech, A. L., & Wilson, J. O. S. (2019). The Australian bank levy: Do shareholders pay? *Finance Research Letters*, *28*, 412–415. https://doi.org/10.1016/j.frl.2018.06.010

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. https://doi.org/10.5089/9781451865660.001

Cihák, M. M., & Hesse, H. (2008). *Islamic banks and financial stability: An empirical analysis* (IMF Working Paper No. WP/08/16). https://doi.org/10.5089/9781451868784.001

Curcio, D., & Hasan, I. (2015). Earnings and capital management and signaling: The use of loan-loss provisions by European banks. *The European Journal of Finance*, *21*(1), 26–50. https://doi.org/10.1080/1351847X.2012.762408

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. https://doi.org/10.1016/j.intfin.2011.07.002

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. https://doi.org/10.1016/j.jfi.2009.04.001

DOI: 10.7172/2353-6845.jbfe.2023.1.1

Delis, M. D., & Staikouras, P. K. (2011). Supervisory effectiveness and bank risk. *Review of Finance*, *15*(3), 511–543. https://doi.org/10.1093/rof/rfq035

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. https://doi.org/10.1093/wber/13.2.379

Devereux, M., Johannesen, N., & Vella, J. (2015). Can taxes tame the banks ? Evidence from the European bank levies. *Saïd Business School, Research Papers*, (April). https://doi.org/10.2139/ssrn.2563634

Devereux, M., Johannesen, N., & Vella, J. (2019). Can taxes tame the banks? Evidence from the European bank levies. *The Economic Journal*, *129*(624), 3058–3091. https://doi.org/10.1093/ej/uez028

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*.

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. https://doi.org/10.1016/j.jeconbus.2004.02.001

ECB. (2022). Opinion of the European Central Bank of 2 November 2022 on the imposition of temporary levies on certain credit institutions (CON/2022/36). *ECB-PUBLIC*, *CON/2022/3*, 1–6.

Edwards, F. R., & Mishkin, F. S. (1995). *The decline of traditional banking: Implications for financial stabilityand regulatory policy*. National Bureau of Economic Research. https://doi.org/10.3386/w4993

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. https://doi.org/10.2307/1913827

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. https://doi.org/10.1016/j.jfineco.2010.02.008

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 (Working Paper No. 18483). *NBER Working Paper Series.*National Bureau of Economic Research.

International Monetary Fund. (2010, June). *A fair and substantial contribution by the financial sector. Final report for the G-20*.

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. https://doi.org/10.1093/rfs/hhq056

Keen, M. (2011). *The taxation and regulation of banks* (IMF Working Paper No. WP/11/206). https://doi.org/10.5089/9781463902179.001

Kogler, M. (2019). On the incidence of bank levies: Theory and evidence. *International Tax and Public Finance*, *26*(4), 677–718. https://doi.org/10.1007/s10797-018-9526-z

Köhler, M. (2012). *Which banks are more risky? The impact of loan growth and business model on bank risk-taking* (Discussion Paper No. 33). Deutsche Bundesbank. https://doi.org/10.2139/ssrn.2796886

Kopecky, K. J., & VanHoose, D. (2006). Capital regulation, heterogeneous monitoring costs, and aggregate loan quality. *Journal of Banking & Finance*, *30*(8), 2235–2255. https://doi.org/10.1016/j.jbankfin.2005.07.018

Kwan, S. (1998). Securities activities by commercial banking firms' section 20 subsidiaries: Risk, return, and diversification benefits. *Working Papers in Applied Economic Theory*, 98-10. Federal Reserve Bank of San Francisco. Citeseer.

Laeven, L., & Levine, R. (2009). Bank governance, regulation and risk taking. *Journal of Financial Economics*, *93*(2), 259–275. https://doi.org/10.1016/j.jfineco.2008.09.003

Lapteacru, I. (2016). *On the consistency of the Z-score to measure the bank risk* (LAREFI Working Paper No. 05). https://doi.org/10.2139/ssrn.2787567

Lepetit, L., & Strobel, F. (2013). Bank insolvency risk and time-varying Z-score measures. *Journal of International Financial Markets, Institutions and Money*, *25*, 73–87. https://doi.org/10.1016/j.intfin.2013.01.004

DOI: 10.7172/2353-6845.jbfe.2023.1.1

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. https://doi.org/10.1016/j.jbankfin.2011.10.012

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. https://doi.org/10.2139/ssrn.2453380

OECD. (2016). *OECD economic surveys Hungary*. Retrieved from www.oecd.org/eco/surveys/economic-survey-hungary.htm

Petersen, M. A. (2009). Estimating standard errors in finance panel data sets: Comparing approaches. *The Review ofżFinancial Studies*, *22*(1), 435–480. https://doi.org/10.1093/rfs/hhn053

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. https://doi.org/10.7206/jmba.ce.2450-7814.218

Puławska, K. (2020). Effects of the bank levy introduction on the interbank market. *International Journal of Finance & Economics*, *online*. https://doi.org/10.1002/ijfe.2180

Puławska, K. (2021a). Taxation of the financial sector: Is a bank levy the answer to the financial crisis? *Journal of Banking Regulation*, 1–15. https://doi.org/10.1057/s41261-021-00178-w

Puławska, K. (2021b). The effect of bank levy introduction on commercial banks in Europe. *Journal of Risk and Financial Management*. https://doi.org/10.3390/jrfm14060279

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. https://doi.org/10.1023/A:1019781109676

Schneider, M. (2001). *Borrowing constraints in a dynamic model of bank asset and liability management* [Mimeograph]. University of Rochester, Department of Economics. Retrieved from https://pdfs.semanticscholar.org/3f6e/70a10e2e07a328f8ccc6890296b4e1db20a8.pdf?_ga=2.204461136.1172160923.1560528342-1305835172.1560528342

Stiroh, K. J. (2004). Diversification in banking: Is noninterest income the answer? *Journal of Money, Credit, and Banking*, *36*(5), 853–882. https://doi.org/10.1353/mcb.2004.0076

Trujillo-Ponce, A. (2013). What determines the profitability of banks? Evidence from Spain. *Accounting & Finance*, *53*(2), 561–586. https://doi.org/10.1111/j.1467-629X.2011.00466.x

Uhde, A., & Heimeshoff, U. (2009). Consolidation in banking and financial stability in Europe: Empirical evidence. *Journal of Banking & Finance*, *33*(7), 1299–1311, https://doi.org/10.1016/j.jbankfin.2009.01.006

Wooldridge, J. M. (2015). *Introductory econometrics: A modern approach*. Cengage learning.

Yeyati, E. L., & Micco, A. (2007). Concentration and foreign penetration in Latin American banking sectors: Impact on competition and risk. *Journal of Banking & Finance*, *31*(6), 1633–1647. https://doi.org/10.1016/j.jbankfin.2006.11.003

DOI: 10.7172/2353-6845.jbfe.2023.1.1