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How to Design a Bank Levy: The Effect of a Levy Scheme on Bank Performance and its Activities[1]

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Abstract

One of the regulatory responses to the 2008 financial crisis was to internalize the costs related to banks' distress by introducing bank levies. More than 23 European banking sectors have been confronted with the new levy regime imposing the additional tax on banks' balance sheet. This study analyzes the effect of the levy introduction on banks' profitability, credit activity, and on their business models. More importantly, we confront two different levy regimes – one imposed on banks' assets and the other on liabilities – to assess their differential impact. A generalized least squares regression with a random effect is performed on a data sample of Hungarian and German credit institutions from 2005 to 2015. The results show that levy introduction weakened banking sectors in terms of their profitability as well as their lending activity. Even though banks try to compensate for the cost of the levies by passing some of the costs on to the customers and restructuring their operations to limit the tax burden, we find that these activities are not sufficient to offset the whole tax burden. We also note that while the asset levy has a more severe effect on banks' profits, the liability levy severely affects banks' lending due to lower interest margin resulting from higher cost of funding. Our research results provide important conclusions for regulators, especially during turbulent periods such as the COVID-19 pandemic to strengthen the banking sectors by considering the levy suspension.

Keywords: bank levy, profitability, lending, stability, regulations, COVID-19.

JEL: C23, C54, G21, G28, E61

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Introduction

The 2007–2008 financial crisis showed that banks' risky operations may produce harsh consequences for economies. These consequences entail not only banks' losses and the significant public resources needed to bail out banks, but also banks' bankruptcies that induce significant social and economic consequences globally. After the 2008 crisis, many proposals emerged on how to protect the banking sector against such turbulences in the future by discouraging banks from taking too high risks. One of these proposals was the introduction of a bank levy (BL) (International Monetary Fund, 2010) which requires to tax banks' balance sheet. Proponents of this reform strategy argue that it is designed as a Pigouvian tax to be applied to the most risky activities on a bank's balance sheet, while promoting safe behavior by excluding it from levy burden. As a result, this should discourage banks from taking on too high risks (Keen, 2011; Capelle-Blancard & Havrylchyk, 2013; Devereux et al., 2013; Buch et al., 2016). Others claim that BLs allow for taxing of possible economic rents enjoyed by the financial sector due to implicit and explicit state guarantees (Capelle-Blancard & Havrylchyk, 2017). Moreover, BL could also offset tax distortions, due to financial services being exempt from VAT and lending to themselves for fiscal optimization (Huizinga, 2002). Consequently, many countries decided to apply this regulatory instrument; however, the taxation scheme differs between countries. For example, 15 European Union countries such as: Austria, Belgium, Cyprus, Germany, Netherlands, Latvia, Portugal, Romania, Slovakia, Sweden, and the United Kingdom decided to introduce a BL on bank liabilities, while Poland, Slovenia, and Hungary imposed it on bank assets. France decided to levy bank capital. While different countries' levy design is still subject of a legislative debate, an increased number of countries, including USA, are considering its introduction.

This recent trend in levying bank operations raises the question of how it will affect banks' performance and their sectoral behavior. Taxing bank operations could disrupt bank activities and affect the economic situation of these countries negatively. Many economists, credit rating agencies, and bankers have warned against the negative consequences ensuing from the introduction of BLs. Specifically, levying banks' assets has been strongly criticized by the media. Moody's (2016) said: "it will result in a decline in net income and would reduce banks' ability to absorb shocks. The tax also threatens to hurt credit growth because it reduces banks' capital creation, which risks adversely affecting economy and resulting in slower GDP growth." European Central Bank (ECB) (2019) argued that "proposed bank tax could have negative consequences for the provision of credit and financial stability and should be analyzed thoroughly before being introduced and may give financial institutions an incentive

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to change their risk profile by restructuring their portfolios in favor of riskier products, by making use of off-balance sheet activities and/or by transferring their assets abroad." This study aims to empirically examine how BLs influence the banking sector's performance and banks' operation. More specifically, we address the following questions: *Have banks' profitability been affected by the introduction of a BL? Can we observe a change in banks' credit activity after levy introduction? Do banks transfer the cost of levy onto the customers? How do banks change their operation as a response to a levy introduction? And finally, which levy regime seems to be the most harmful to the banking sector?*

Regulators can impose levies on either a bank's assets or on its liabilities. However, independent from the levy scheme, the new tax constitutes an additional burden on banks' operation costs. Therefore, it can be expected that BLs will negatively affect banks' performance. However, this effect is not as clear in practice. Banks may try to pass the cost of the levy on to the customer by increasing lending rates as well as the cost of other banking services in the form of fees and commissions (Albertazzi & Gambacorta, 2010; Huizinga et al., 2012; Kogler, 2019). These effects may weaken the negative impact of BLs on bank profitability. Moreover, banks may also attempt to implement changes to their balance sheet by promoting levy-exempted activities or operations, what many regulators allow for. Such activities are either exempted from levy burden or are levied at a more favorable rate. For example, King (2013) suggests that banks tend to restructure their balance sheet in response to changes in tax rules. Alternatively, banks may also try to shift their activities into higher margin products by changing their business models, allowing them to ease the levy's burden on their performance (Rajan, 1995; Roengpitya et al., 2014; Weistroffer, 2013). Consequently, it is difficult to estimate the average effect of levy introduction on banks' performance, as banks may implement several steps to weaken its impact. More importantly, it is even more difficult to determine which levy scheme has a more burdensome effect on the banking sector. While a levy on a bank asset may promote easier applicability of a pass-through effect, a levy on banks' liabilities will be more difficult to fully pass on to the customer via lending rates. In turn, it may even induce an increase in cost of funding for banks if regulators promote specific funding sources by exempting them from levies, as in Germany. Consequently, we argue that it is very difficult to determine the consequences of levy introduction on banking sectors' profitability and activity as well as to notice the most harmful levy scheme.

This study investigates the impact of levy introduction on banking sector profitability as well as different banking operations by considering two levy schemes – levies on assets and levies on liabilities – while controlling for other local features. To answer our research questions, we compare the experiences of two countries: Germany and

Hungary. Both countries have introduced BLs, with the former having imposed it on bank liabilities and the latter on bank assets. We use panel data of 47 Hungarian and 292 German credit institutions for the period 2005–2015. This period allows us to assess the period before the levy introduction (Germany introduced the levy in 2011 while Hungary introduced it in 2010) and compare it with the aftermath of introducing the levy. Comparing the effects of different levy schemes offers an important contribution to the literature and helps us to find a superior solution for the levy scheme. To address the effect of levy on banks' profitability, we analyze the impact on banks' profits, various profitability measures, and on banks' interest margin and non-interest income. To accomplish the second part of the study related to a change of business models, we test the impact of levies on banks' credit activity, other earnings assets, and sources of funding. As a methodology, we use a generalized least squares (GLS) regression with random effect clustering standard errors at individual bank level. The choice of using this model was confirmed by diagnostic tests and the Hausman test.[4] The Hausman test indicates that random effect is more preferable than the fixed-effect. The result is not surprising as random effect gives more precise estimates in small samples and unbalanced panel. Moreover, the random effects estimator permits us to estimate the effects of variables that are individually time-invariant. It is also more preferred where the variables experience a slow-moving nature. However, we also prove the robustness of our results using fixed-effects as well as a difference--in-differences estimator.

Our GLS regression results present interesting implications. They unambiguously show that the levy introduction has negatively affected banking sector performance, independently from the levy scheme. We note that the levy introduction had a statistically significant effect on return on assets ratio (ROA) in both countries. The impact was much higher when we, however, consider the countries separately. Interestingly, the regressions on the individual countries indicate that the levy negatively affects all profit measures, including the absolute values. However, our results also suggest that the magnitude of the effect is much higher in Hungary, where the levy was imposed on the entire asset side (with the exclusion of interbank lending, which constitutes a small portion of banks' assets) than in Germany, where a significant portion of liabilities, in the form of deposits, was excluded from the levy. Interestingly, banks' profits have been affected, even though banks try to pass the cost of the levy on to customers. However, the pass-through effect was much more visible in Germany than in Hungary which might confirm the studies showing that it is easier to implement it

[4] The results on Hausman and Breusch Pagan tests on the usage of fixed versus random effect estimator and random effect versus pooled OLS estimator are available upon request.

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in the larger and more diversified banks than in more specialized institutions (Weth, 2002; Hanweck & Ryu, 2005; Molyneux et al., 2019). However, in line with other studies we also find that net interest margin has declined more in Germany than in Hungary due to potential higher cost of deposit funding. Consequently, our regression results suggest that the levy scheme induced on asset without any balance sheet exemptions seems to be the most harmful for banking sector performance.

Interestingly, our regression results document that banks have restructured their business in response to the levy implementation. For example, banks in Germany have moved to a higher deposit funding, while simultaneously decreasing their credit activity. Further, although Hungarian banks have not reduced their lending activity significantly, we notice that these banks have shifted their assets to other investment, probably more profitable, investment products to be able to compensate for the tax burden. Consequently, our regression results document that banks modify their business models toward the tax-exempt or probably to higher margin activities to limit the levy burden, depending on the levy schemes.

Overall, our regression results indicate that levies on banks' assets are more damaging to banks' performance than levies on banks' liabilities, as it covers a bigger scale of operation, and generally does not allow for significant levy exclusions. In contrast, levy exclusions lead to banks biased toward levy-excluded operations, which might induce higher costs for banks. Consequently, banks react by a decline in lending activity.

Although the concept of BL has been constantly evolving in academic literature, there is still limited number of studies analyzing the influence of levy introduction on banking sector operations. Among the most important is the work of Buch et al. (2014). The authors analyze the effect of BLs on banks' credit activity and its cost in Germany. Using a difference-in-differences approach for the period 2008–2011, the authors show that banks have reacted significantly to the levy introduction by increasing tax-exempt deposits; however, they decreased lending activity at the same time. The shift toward deposit funding has increased the cost of funding, leading to a decrease in lending. The result seems to be more significant for larger banks who were subject to a progressive tax in Germany. Another study to address BL is the work of Capelle-Blancard and Havrylchyk (2017) that analyzes the effect of levy introduction on lending rates in the Hungarian market for the period 2008–2012. They find that banks try to pass the cost of the levy on to the customers. They also document that only customers with limited elasticity – such as households or those with outstanding loan volumes – noticed an increase in their lending rates. New household borrowers as well as the corporate

sector did not notice an increase in lending rates; this illustrates their higher elasticity in loan demand. Haskamp (2018) analyses the effect of BL on lending rates among German savings and cooperative banks. They also find that these banks increased their lending rates. Moreover, they discover that this behavior induces a spill-over effect into non-levy competitors, who then also start increasing their rates. Few studies analyze the effects of levies within a theoretical framework. For example, Kogler (2019) presents a Monti-Klein model predicting that banks shift the burden of a BL to borrowers by raising lending rates. However, Mauro (2010) use a theoretical model to forecast responses to levy introduction on lending rates. Using a stylized model of banks' lending decisions, they predict that a levy of 10 bps on liabilities raises the lending rate by about 7 bps in the case of a full pass-through; in an intermediate case, the increase of the lending rate is limited to 4 bps. However, these forecasts assume an exogenous extent of the pass-through. Consequently, these studies document that the cost of banking services go up as a result of a levy introduction.

Some other studies have analyzed the effect of BLs on banks' risk behavior. For example, Devereux, Johannesen, and Vella (2015) analyze the effect of BLs on banks' capital structure. They find that, although BL promotes less risky equity financing, banks often try to shift their risk into the asset side to compensate for its cost. Schweikhard and Wahrenburg (2013) analyze the contribution to systemic risk of different levy schemes introduced in Germany, France, and the United Kingdom. Based on a sample of 41 large European and United States banks, the authors find no evidence that the BL decreases systemic risk. However, Bremus, Schmidt, and Tonzer (2020) analyze the effect of BLs on banks' leverage using panel data from European banks from 2006 to 2014. They find that a levy decreases banks' leverage, as liabilities become more expensive; however, the effect is non-linear. Furthermore, higher tax rates seem to be ineffective in decreasing this ratio.

Our study significantly extends existing literature in three fields. First, we extend upon the above studies concerning the effect of levies on banks' profitability and their operations. Although some studies consider the pass-through effect of BL on lending rates as well as deposit rates, they do not investigate how these actions have translated into banking sector profitability measures. More importantly, the existing academic studies do not investigate the effect of levy on total banking sector operation, mostly concentrating on individual aspects from banks' behavior which makes the understanding of the total levy effect more difficult. Second, our study period is much broader than most existing studies who mostly consider one or two years succeeding the levy introduction. Our longer study period allows us to observe structural changes in banks' behavior that occurred as a result of the levy introduction. Third, we contrast

 DOI: 10.7206/cemj.2658-0845.85

two levy schemes while controlling for their non-linear effects resulting from progressive levy rate depending on bank sizes. Our analysis allows us to draw more precise conclusions regarding the influence of the levy on banking sector operation and its stability.

The remainder of this study is organized as follows. The next section presents the Hungarian and German BL designs, the data, and the methodology. Section three presents summary statistics, while section four covers the empirical results. Section five presents our robustness checks. The last section concludes the paper.

Research design

The structure of BLs in Hungary and Germany

Bank levies in Hungary

Hungary was one of the first countries to implement BLs. Unlike other countries, Hungary – and later Poland – decided to tax the asset side of financial institutions' balance sheet. The BL was introduced in Hungary based on an act adopted in July 2010 and has been collected since September 2010. The levy originated not only to recover some of the budget funds allocated to saving the financial sector, but also to quickly improve Hungary's economic situation and explore new sources of financing for the state budget.

Interestingly, the Hungarian levy applies to all financial institutions, even those operating at a loss. However, it allows exemption from taxation on interbank lending. When it was introduced, the tax was presented as a temporary measure; therefore, the tax base was fixed at the amount of assets from 2009. The levy was set at 0.15% of the tax base for small financial institutions with assets below 50 billion Forints (around 185 million EUR) in value and at 0.53% of the tax base for larger institutions. This means that the ratio of total tax paid by large financial institutions has more than tripled, from 0.15% of their total assets to 0.55% (Capelle-Blancard & Havrylchyk, 2017).

Bank levies in Germany

Germany introduced a progressive BL in 2011, in the wake of the financial crisis. The main aim of this levy was to burden bank liabilities, which were calculated from the previous year's balance sheet. Its design, however, allows for exemption of less risky funding sources. This means that the contribution-relevant liabilities are all liabilities

(according to the annual statement of the previous financial year ending before 1 March of the contribution year) less (1) liabilities towards 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). The levy design in Germany assumes a progressive taxation; this means that in the case of liabilities between EUR 300 million and EUR 10 billion, the levy rate is 0.02%. However, it increases to 0.06% if the bank's relevant liabilities exceed EUR 30 billion. Interestingly, banks with contribution-relevant liabilities below EUR 300 million are exempt from paying the tax. Moreover, while the German levy applies to foreign branches of German banks, it does not apply to foreign subsidiaries. This differs significantly from other countries, in which the BL applies to foreign affiliates. Finally, in Germany, small and development banks are exempt from the levy. The revenues from BLs in Germany are estimated to be the lowest among the European Union countries, while that of Hungary is one of the highest.

Sample

To verify effect of BL introduction on bank behavior, we analyze the behavior of all credit institutions in Germany as well as Hungary for the period 2005–2015. This data sample allows us to compare the behavior of banks under two different levy regimes and their behavior before and after the levy introduction. More specifically, the first part of the study period covers the pre-BL introduction period in Germany (2005–2010) and in Hungary (2008–2009), while the later years include the post-BL introduction period in Germany (2011–2015) and in Hungary (2010–2015). The sample includes the data of 40 Hungarian and 291 German credit institutions and all financial data come from unconsolidated financial statements. We argue that the effect of the BL should be more evident in unconsolidated than consolidated statements, as conglomerate financial institutions might make certain adjustments and shift their activities among entities to decrease their tax burden, which will not be visible in consolidated statements (Diaz et al., 2004). All data were extracted from the Orbis Bank Focus database that contain financial information on banks and other financial institutions worldwide.

Methodology

To evaluate the effect of levy introduction on bank performance, we estimate the following model for the two countries separately.

 DOI: 10.7206/cemj.2658-0845.85

$$PROFIT_{jt} = \beta_0 + \beta_1 BL_t + \beta_2 \text{SIZE}_{jt-1} + \beta_3 \text{CapitalRatio}_{jt-1} + \beta_4 \text{CreditRisk}_{jt-1} + \\ + \beta_5 \text{LiquidityRatio}_{jt-1} + \beta_6 \text{Efficiency}_{jt-1} + \beta_7 \text{Inflation}_{jt} + \beta_8 \text{GDPgrowth}_{jt} + \\ + \beta_9 \text{BL dummy}_t + \varepsilon_{jt} \quad (1)$$

We define bank profitability ($PROFIT_{jt}$) as follows: (1) the natural logarithm of profit before tax of a bank j at time t; (2) profit before tax to total assets ratio of a bank j at time t; and (3) return on average assets ratio of a bank j at time t. Such ratios have been widely discussed as measures of bank performance in existing works (Schepens 2016; Barth et al. 2017; Borio et al. 2017; Gambacorta and Shin 2018).

To verify whether banks pass their tax burden on their customers, we estimate the following model:

$$\text{Financial Ratios}_{jt} = \beta_0 + \beta_1 BL_t + \beta_2 \text{SIZE}_{jt-1} + \beta_3 \text{CapitalRatio}_{jt-1} + \\ + \beta_4 \text{CreditRisk}_{jt-1} + \beta_5 \text{LiquidityRatio}_{jt-1} + \beta_6 \text{Efficiency}_{jt-1} + \beta_7 \text{Inflation}_{jt} + \\ + \beta_8 \text{GDPgrowth}_{jt} + \beta_9 \text{BL dummy}_t + \varepsilon_t \quad (2)$$

where $\text{Financial Ratios}_{jt}$ is defined such as: (1) the natural logarithm of net interest income of a bank j at time t; (2) the net interest margin of a bank j at time t; and (3) the net fees and commission revenues of a bank j at time t. All of these ratios have been used as measures of service costs in existing literature (Borio et al., 2017; Maxfield et al., 2018).

Finally, to test if banks restructure their balance sheet as a response to BL introduction, we estimate the following equation for Hungary:

$$CREDIT_{tj} = \beta_0 + \beta_1 BL_t + \beta_2 \text{SIZE}_{jt-1} + \beta_3 \text{CapitalRatio}_{jt-1} + \beta_4 \text{CreditRisk}_{jt-1} + \\ + \beta_5 \text{LiquidityRatio}_{jt-1} + \beta_6 \text{Efficiency}_{jt-1} + \beta_7 \text{Inflation}_{jt} + \beta_8 \text{GDPgrowth}_{jt} + \\ + \beta_9 \text{BL dummy}_t + \varepsilon_{jt} \quad (3)$$

where $CREDIT_{jt}$ represents following measures: (1) loans growth of a bank j at time t; (2) natural logarithm of loans of a bank j at time t; (3) loans to total assets of a bank j at time t; (4) natural logarithm of other earnings assets of a bank j at time t; and (5) other earnings assets to total asset of a bank j at time t. These ratios have been widely used to measure different bank activities in existing literature (Ghosh, 2015; Gilje et al., 2016; Borio et al., 2017; Fahlenbrach et al., 2017).

Additionally, we also test the effect of levy on liabilities structure at German banks by estimating the following equation:

$$DEPOSIT_{jt} = \beta_0 + \beta_1 BL_t + \beta_2 \text{SIZE}_{jt-1} + \beta_3 \text{CapitalRatio}_{jt-1} + \\ + \beta_4 \text{CreditRisk}_{jt-1} + \beta_5 \text{LiquidityRatio}_{jt-1} + \beta_6 \text{Efficiency}_{jt-1} + \beta_7 \text{Inflation}_{jt} + \\ + \beta_8 \text{GDPgrowth}_{jt} + \beta_9 \text{BL dummy}_t + \varepsilon_{jt} \quad (4)$$

where $DEPOSIT_{jt}$ is defined as follows: (1) deposit growth of a bank *j* at time *t*; (2) natural logarithm of deposit of a bank *j* at time *t*; and (3) deposit to total liabilities of a bank *j* at time *t*. These ratios have been widely discussed in banking literature on bank funding sources (Berger et al., 2005; Abedifar et al., 2016; Gilje et al. 2016).

To verify the impact of BLs on profitability measures, we use a dummy variable for the BL. The dummy takes the value of 1 for years in which the BL was applied, and 0 otherwise. All the control variables appear in the regressions as lagged variables to limit the endogeneity between banks' characteristics and their performance measures. We consider a one-year lag in models due to the limited number of observations.

To avoid the omitted variable biased problem, we control for additional factors discussed in existing banking literature as impacting the profitability measures. To this end, we include a "bank size" variable, measured by total assets (in natural logarithm, *SIZE*), because it has been shown to be an important determinant of a financial institution's profitability. We expect that larger financial institutions will be more profitable, due to economy of scale and scope (Wheelock and Wilson 2012). Moreover, we also control for bank efficiency, as defined by institutions' cost-to-income ratio (*Efficiency*), as existing research shows that inefficient financial institutions take on more risk, thus making them less profitable (Kwan & Eisenbeis, 1997; Williams, 2004). We also use the liquidity ratio (*Liquidity Ratio*), defined as current assets to total assets. Liquidity is defined as a bank's ability to meet obligations as they become due without incurring unacceptable losses. Research shows that more liquid financial institutions are less profitable, because financial institutions that hold highly liquid assets tend to have relatively lower income. This is because liquid assets are less risky, therefore attracting lower rates of returns (Kashyap et al., 2002). We also include equity to total assets ratio (*Capital Ratio*). This ratio measures the institutions' financial strength and should have an effect on the profitability of the financial institution. More capitalized banks tend to display higher profitability, due to less incentives to engage in higher-risk projects (Lee & Hsieh, 2013). Finally, we also control for credit risk (Credit Risk), defined as loan loss provisions to total assets. Existing research document that higher risk is more often associated with lower profits, due to higher bank losses (Athanasoglou et al., 2008).

Our macroeconomic variables include inflation (*Inflation*) and GDP growth (*GDP growth*). For example, Huybens & Smith (1999) show that inflation artificially increases

 DOI: 10.7206/cemj.2658-0845.85

banking margins. Furthermore, Demirgüç-Kunt et al. (2004) note that both inflation and economic growth can influence interest margins. They find that inflation has a positive impact on these margins. The relationship between inflation and financial institutions' performance, however, depends on whether the inflation is anticipated or unanticipated. We define the inflation rate as the rate of change in the consumer price index. High inflation may increase the net interest revenue if lending rates reflect inflation more accurately than deposit rates (Huizinga et al., 2012).

To estimate our regressions, we use GLS methodology with random effects. Our choice of methodology was dictated by our diagnostics tests, including the Hausmann test, which categorically point toward random effect, rather than fixed-effect. Nevertheless, we present the regressions with the bank fixed-effect in the robustness check section.

Summary statistics

Tables 1 and 2 present the summary statistics of the financial data on Hungarian and German credit institutions for two sub-samples before and after the introduction of BL, respectively (Table 1 and 2).

The bank level data presented in Tables 1 and 2 suggest that bank profitability measured by ROA increased slightly in Hungary, while it decreased significantly in Germany after the introduction of BLs (2010 in Hungary and 2011 in Germany). We also notice that the "Credit risk" variable decreases after BL introduction in both countries, which might suggest that banks decreased their lending after BLs introduction; indeed, the loan growth variable in both Tables indicate that lending activity seem to decrease in both countries after levy incline. Moreover, the variable "other earnings asset," a proxy for other bank investment activities, increased slightly in Hungary after levy introduction. At the same time, there does not seem to be a significant shift in deposit funding in Germany.

We also find that the interest margin increased in Hungary; however, it decreased in Germany after the BL introduction. This suggests that while banks in Hungary increased only their lending rates, banks in Germany were probably forced to increase their deposit rate to encourage tax-exempted deposits leading to a drop in the interest margin. Existing official statistics confirm an increase in deposits at German banks, which shows that German households hold more than 40% of their total financial assets in the form of bank deposits (ECB 2013).

Table 1. Summary statistics of unconsolidated financial statements of Hungarian and German credit institutions before the implementation of the BL (2005–2009 in the case of Hungary and 2005–2010 in Germany)

Variables	Hungarian credit institutions					German credit institutions				
	N	mean	sd.	min.	max.	N	mean	sd.	min.	max.
Efficiency	49	63.880	21.030	6.641	94.950	1,024	66.239	19.431	0.000	269.700
GDPgrowth (%)	49	-2.761	3.764	-6.564	0.889	1,024	1.274	3.266	-5.619	4.080
Inflation (%)	49	5.157	0.938	4.209	6.066	1,024	1.608	0.746	0.800	3.100
Liquidity Ratio (%)	49	38.800	26.300	0.300	91.900	1,024	16.200	14.500	0.000	96.700
Credit Risk (%)	49	1.000	3.880	-1.990	20.200	1,024	0.400	0.500	-4.000	8.200
ROA (%)	49	1.261	2.007	-5.123	5.931	1,024	5.498	15.306	-2.000	67.000
Total Asset in '000 EUR	49	1,861	3,693	27.949	17,943	1,024	23,840	119,200	100	1,783,000
Capital Ratio (%)	49	12.200	8.400	-2.900	39.400	1,024	6.200	4.3	0.000	52.300
Profit Before tax (ln)	44	14.6587	1.840	8.699	18.901	955	8.868	1.710	4.605	15.707
Profit to Assets (%)	49	1.500	2.200	-5.200	6.400	1,024	0.381	0.353	-1.397	3.280
Net interest margin (%)	49	1.324	0.868	-1.772	2.955	1,015	0.639	0.621	-1.981	5.120
Net interest income (ln)	49	5.156	4.573	0.170	19.213	1,015	10.618	1.588	6.214	15.846
Hungary: other earning assets (ln)	49	17.572	2.136	12.169	21.700					
Germany: Customer Deposits (ln)						1,015	13.885	1.890	4.605	20.069

Source: ORBIS Bank Focus.

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Table 2. Summary statistics of unconsolidated financial statements of Hungarian and German credit institutions after the introduction of the BL (2010–2015 in the case of Hungary and 2011–2015 in Germany)

Variables	Hungarian credit institutions					German credit institutions				
	N	mean	sd.	min.	max.	N	mean	sd.	min.	max.
Efficiency	194	65.12	20.090	10.800	98.420	701	69.149	25.370	0.100	161.326
GDP growth (%)	194	1.810	1.848	-1.603	4.047	701	1.839	1.171	0.490	3.660
Inflation (%)	194	2.444	2.346	-0.222	5.668	701	1.112	0.815	0.200	2.100
Liquidity (%)	193	34.900	24.900	00.100	93.100	701	16.700	19.000	0.000	99.500
Credit Risk (%)	193	0.746	1.720	-6.370	10.000	701	-0.100	0.700	-4.100	4.200
ROA (%)	194	1.265	2.839	-7.666	14.990	701	1.203	6.649	-0.870	65.00
Total Asset in '000 EUR	194	1,943	4,057	134	23,485	701	31,400	437,000	362	11,800,000
Capital Ratio (%)	194	12.100	8.400	0.990	48.100	701	8.500	5.600	0.000	64.300
Profit Before tax (ln)	157	14.395	1.827	5.991	18.899	664	8.749	1.696	0.000	16.784
Profit to Assets (%)	194	1.560	3.308	-7.374	18.520	701	0.396	0.413	-4.686	6.360
Net interest margin (%)	192	1.390	0.709	-0.307	3.279	699	0.558	0.823	-5.521	3.797
Net interest income (ln)	192	15.564	1.583	7.003	19.598	699	10.785	1.743	0.693	18.054
Hungary: other earning assets (ln)	188	17.730	2.398	8.517	22.155					
Germany: Customer deposits (ln)						693	13.941	1.847	3.637	23.079

Source: ORBIS Bank Focus.

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Results

Do BLs destroy bank profitability?

In this Section we verify how and which BL scheme affects banks' profitability. Theoretically, each additional cost burden has a negative effect on bank performance, as it increases operating costs. However, some existing studies argue that banks try to pass the additional costs on to their clients. For example, Albertazzi and Gambacorta (2010) document that banks tend to shift at least 90% of their corporate income tax burden into their lending rates. Similarly, Demirgüç-Kunt and Huizinga (1999; 2001) and Chiorazzo and Milani (2011) find that corporate income taxes are passed on to banks' customers via increases in their net interest margins. Therefore, the authors conclude that an increase in corporate rates did not have a significant impact on banks' profitability. At the same time, Albertazzi and Gambacorta (2010) and Caminal (2003) show that corporate income tax can have an impact on lending rates, only if it increases the cost of equity. Moreover, other studies claim that banks can pass the effect onto customers only to a limited extent, and that this decision depends on customers' demand elasticity, bank size, or market power (Mauro, 2010; Buch et al., 2016; Capelle-Blancard & Havrylchyk, 2017; Molyneux et al., 2020). Consequently, the effect of BLs on banks' performance is not clear, as it depends on the banks' reaction to it. What is even more unclear, is which levy scheme exerts a higher reaction on the banking sector.

We argue that BLs on assets might affect banks' performance more severely than levies on liabilities, due to a larger scale of taxation. This is because regulators generally decide to tax the whole asset side. This is exactly the case in Hungary, however in Poland regulators decided to exclude the government securities from the levy burden. Yet, in Germany, mainly bank interbank lending has been imposed, with deposits having been exempted. We argue that considering banks' performance, the scale of levy matters significantly.

Table 3 presents the regression results of how BL impacts banks' performance using the panel data for both countries.

However, Tables 4 and 5 document the regression results on the sub-samples of the two countries to see the differential impact of the levy on banks' profitability measures, depending on its scheme. Moreover, as the levy rate varies according to the size of the institution, we also include the interaction terms *BL*Total Asset* for Hungary and *BL*Relevant Liabilities* for Germany, to see whether there is a differential impact on banks' performance based on bank's size.

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Table 3. Data presenting estimates based on GLS regressions with a random effect on German and Hungarian credit institutions in 2005–2015. Data has been sourced from unconsolidated financial statements. Institution-specific characteristics appear as one-year lagged variables. The bank levy (BL) is represented by a dummy variable indicating 1 for all years the levy applies to, and zero for all remaining years. Robust standard errors that control for clustering at the financial institution level are reported in brackets

Variables	German and Hungarian credit institutions					
	Profit before tax (ln)		Profit before tax to total assets		Return on assets	
	(1)	(2)	(3)	(4)	(5)	(6)
Efficiency	-0.004	-0.004	0.001	0.001	0.003	0.003
	(0.004)	(0.004)	(0.001)	(0.001)	(0.005)	(0.005)
GDP growth	-0.035	-0.033	-0.001	0.002	-0.107	-0.107
	(0.023)	(0.023)	(0.010)	(0.009)	(0.096)	(0.097)
Inflation	0.223**	0.221**	0.021	0.014	0.141	0.142
	(0.090)	(0.087)	(0.049)	(0.049)	(0.161)	(0.161)
Capital Ratio	0.038	0.040	0.035**	0.037**	-0.039	-0.039
	(0.027)	(0.027)	(0.018)	(0.018)	(0.029)	(0.029)
Credit Risk	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Liquidity ratio	-1.731***	-1.746***	-0.081	-0.0908	-0.438	-0.436
	(0.646)	(0.648)	(0.278)	(0.275)	(1.918)	(1.921)
Size	0.103***	0.105***	-0.033**	-0.030**	0.189**	0.189**
	(0.0378)	(0.039)	(0.013)	(0.014)	(0.093)	(0.093)
BL	0.363***	0.381***	0.023	0.042	-3.517***	-3.518***
	(0.132)	(0.133)	(0.031)	(0.031)	(0.602)	(0.607)
BL*Total Asset		0.000		0.000***		0.000
		(0.000)		(0.000)		(0.000)
Constant	7.155***	7.130***	0.929***	0.919***	2.378*	2.378*
	(0.560)	(0.567)	(0.240)	(0.241)	(1.274)	(1.275)
Number of obs.	1,842	1,842	1,842	1,842	1,842	1,842
R-squared	0.154	0.088	0.144	0.093	0.027	0.027

Symbols *, **, *** represent statistical significance at the level of 10%, 5%, and 1%, respectively.

Source: own calculations.

Table 4. Data presenting estimates based on GLS regressions with a random effect on Hungarian credit institutions appear as one-year lagged variables in all. The bank levy (BL) is represented by a dummy variable indicating 1 for all years the levy applies to, and zero for all remaining years. Robust standard errors that control for clustering at the financial institution level are reported in brackets

Variables	Hungarian credit institutions					
	Profit before tax (ln)		Profit before tax to total assets		Return on assets	
	(1)	(2)	(3)	(4)	(5)	(6)
Efficiency	-0.003***	-0.001	0.001	0.001	2.759	-0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(1.151)	(0.004)
GDP growth	0.537	0.993*	0.029**	0.030**	-0.002**	2.639**
	(0.566)	(0.553)	(0.014)	(0.013)	(0.003)	(1.251)
Inflation	0.302	0.903	0.030**	0.030**	2.617**	2.741**
	(0.563)	(0.552)	(0.012)	(0.012)	(1.275)	(1.138)
Capital Ratio	-0.001	-0.038	-0.001***	-0.001***	-0.119**	-0.118**
	(0.022)	(0.025)	(0.001)	(0.001)	(0.048)	(0.048)
Credit Risk	-5.379	-13.700***	-0.367*	-0.373*	-38.959*	-40.004*
	(3.719)	(4.156)	(0.212)	(0.213)	(22.319)	(22.485)
Liquidity ratio	-1.572	0.067	0.068*	0.071*	6.416**	6.769**
	(1.333)	(1.076)	(0.038)	(0.039)	(3.036)	(3.095)
Size	0.061	0.012	0.001	-0.001	0.028	-0.076
	(0.243)	(0.091)	(0.002)	(0.001)	(0.185)	(0.123)
BL	-4.010	-21.620***	-0.175**	-0.223**	-15.207*	-21.914**
	(3.650)	(5.067)	(0.089)	(0.093)	(8.508)	(9.040)
BL*Total Asset		0.746***		0.002		0.334
		(0.138)		(0.003)		(0.274)
Constant	1.929	12.470**	0.001*	0.089	20.907*	11.680**
	(1.358)	(4.569)	(0.076)	(0.063)	(9.172)	(5.360)
Number of obs.	201	201	243	243	243	243
R-squared	0.225	0.738	0.110	0.722	0.756	0.766

Symbols *, **, *** represent statistical significance at the level of 10%, 5%, and 1%, respectively.
Source: own calculations.

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Table 5. Data presenting estimates based on GLS regressions with a random effect on German credit institutions in 2005–2015. Data have been sourced from unconsolidated financial statements. Institution-specific characteristics appear as one-year lagged variables in all specifications. The bank levy (BL) is represented by a dummy variable indicating 1 for all years the levy applies to, and zero for all remaining years. Robust standard errors that control for clustering at the financial institution level are reported in brackets

Variables	German credit institutions					
	Profit before tax (ln)		Profit before tax to total assets (%)		Return on assets	
	(1)	(2)	(3)	(4)	(5)	(6)
Efficiency	-0.137	-0.001	-0.095	-0.001	2.291	0.011
	(0.161)	(0.002)	(0.111)	(0.001)	(1.879)	(0.012)
GDP growth	-1.713**	-1.723*	-0.350	-0.360	-5.256	-2.720
	(0.858)	(0.943)	(0.280)	(0.346)	(5.554)	(5.077)
Inflation	-2.234**	-2.214**	-0.427	-0.412	-5.997	-2.553
	(1.019)	(1.114)	(0.331)	(0.404)	(6.923)	(6.277)
Capital Ratio	-0.619	-0.498	-0.293**	-0.314**	-10.530***	-2.208
	(0.677)	(0.697)	(0.135)	(0.143)	(3.461)	(2.329)
Credit Risk	0.001	0.001	0.001	-0.001	-0.001**	-0.001*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Liquidity ratio	-0.543**	-0.511*	-0.140*	-0.154**	4.844	-0.456
	(0.256)	(0.286)	(0.078)	(0.076)	(4.425)	(2.421)
Inflation	-2.234**	-2.214**	-0.427	-0.412	-5.997	-2.553
	(1.019)	(1.114)	(0.331)	(0.404)	(6.923)	(6.277)
Size	0.147***	0.161***	-0.001	-0.007	0.567	0.522*
	(0.029)	(0.028)	(0.010)	(0.009)	(0.389)	(0.267)
BL	-0.614**	-0.602**	-0.157**	-0.143*	-12.62***	-3.335*
	(0.252)	(0.260)	(0.073)	(0.078)	(2.821)	(1.795)
BL*Relevant Liabilities		0.001		-0.001**		-0.001
		(0.001)		(0.001)		(0.001)
Constant	11.270***	11.06***	1.693**	1.534*	13.734	1.161
	(2.008)	(2.205)	(0.747)	(0.797)	(14.394)	(12.83)
Number of obs.	1,619	1,619	1,725	1,725	1,766	1,725
R-squared	0.509	0.500	0.0002	0.0002	0.041	0.028

Symbols *, **, *** represent statistical significance at the level of 10%, 5%, and 1%, respectively.

Source: own calculations.

The regression results in Tables 3 offers interesting conclusions. The estimation results document that banks' profitability ratio has been severely affected while absolute profits not. These results are also highly statistically significant. The estimations might suggest that in total the scale of banking operation has not been severely affected by levy introduction, yet probably mainly banking margins. The conflicting outcome might be, however, a differential effect which the levy scheme may impose on banks' operations depending whether it is on asset or liability side. However, in general the regression confirms other outcomes documenting that additional taxation is disruptive to banks' performance (Albertazzi & Gambacorta, 2010; Merz & Overesch, 2016). More importantly, when considering the two countries separately, our results indicate even higher negative effect of BLs (Table 4 for Hungary and Table 5 for Germany). The results show that the levy has a negative effect on all of our performance measures in both countries. However, we do note that the levy has a more severe impact on banks' profits in Hungary than in Germany. The size of the coefficient, especially on ROA, is much higher in the former country than in the latter. This result is not surprising, considering that the scale of banks' taxation in Hungary was much higher than in Germany. Interestingly, we do not notice any significant differences related to the sizes of institutions. We only notice that in Hungary, the absolute profits decreased more severely at smaller institutions than at larger ones, while in Germany, the profitability ratio decreased more severely at larger banks. These results suggest that smaller and more specialized institutions have more difficulty in adjusting their business models to compensate for the additional tax burden. However, the results of Germany documents that progressive levy rate mostly burdens the profitability ratio of larger institutions. The result is in line with Buch et al. (2016).

Considering the other explanatory variables, our results show that credit risk – measured by the loan loss provision to total asset ratio – is negatively correlated with the profitability of financial institutions. This result is in line with existing studies confirming that financial institutions that are more inclined to take risks suffer higher loan losses and are, consequently, less profitable (Leventis et al., 2011). Moreover, our results suggest that the capital ratio is negatively correlated with some profitability measures. This indicates that an increase of equity in proportion to total assets decrease bank profitability (Hoffmann, 2011). We also find that liquidity measures provide mixed results for bank profitability. While we find a positive coefficient for the Hungarian sample, the result is opposite for Germany. This inconsistency might be due to differences in source of banks' funding between these two countries. Finally, some of the regression results suggest that bank performance is clearly procyclical, tending to increase in phases of economic upturn and decrease during periods of economic downturn (Demirgüç-Kunt et al., 2004).

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Do banks pass the cost of BLs on to their customers?

There is a growing body of literature on banks' reaction to regulatory changes, including interest rate movements. The majority of studies attest that banks increased the cost of their services as a result of tightening regulatory environment (Campbell et al., 2015; Behn et al., 2016; Benetton et al., 2020; Fraisse et al., 2020). Interestingly, the scale of the pass-through effect seems to depend on the side of the impact of regulatory changes. Changes that have a positive effect on banks' operations – like increases in official interest rates – are passed faster than decreases in the central bank's interest rates (Valadkhani & Anwar, 2012). Moreover, banks' reactions may also be heterogenous within the financial products. For example, the pass-through effect is slower for retail banking products (deposits, consumer loans, and mortgages) than for corporate products (corporate loans) (Rocha, 2012; Capelle-Blancard & Havrylchyk, 2017). Logically, short-term products seem to be more responsive than long-term products (Goddard et al., 2007; Becker et al., 2012).

Consistent with the above literature as well as with Buch et al. (2016) and Capelle-Blancard and Havrylchyk (2017), we expect that banks pass on the cost of BLs to their customers by charging higher rates for their products and services. This is noted in both lines of business: interest and non-interest. However, we also expect that the pass-through effect will have a higher impact on banks' margins in Hungary than in Germany. This is because German banks will likely also have to increase their deposit rate to be able to take advantage of the levy exemption (Buch et al., 2016).

To determine to what extent BL has impacted the cost of banking services, we regress the levy dummy on four variables proxying different income types: (i) *net interest margin* (%), (ii) *net interest income* (ln), and (iii) *net fees and commissions* (ln). We expect that if banks pass the cost of their tax burden on to customers, we will see an increase in these variables after the levy introduction, all else holding constant. The results of the panel data are presented in Table 6.

Again, both countries use a higher rate to tax larger banks. In addition, Germany uses a progressive rate that increases with the size of banks' relevant liability. Therefore, we argue that smaller and bigger banks may react to the pass-through effect differently. Moreover, they may also behave differently because of the scale and scope of their operations. Smaller financial institutions might be less flexible to consider changes to their lending rates, as they are at greater risk of losing their clients than larger banks (Berlin & Mester, 1998; Berger et al., 2005; Molyneux et al., 2020). Consequently, similar to previous regressions, we include the interactive term consisting of *BL*Total*

Asset for the Hungarian sample and *BL*Total Liability* for Germany. Tables 7 and 8 present the regression results for each country separately.

Table 6. Data presenting estimates based on GLS regressions with a random effect on German and Hungarian credit institutions between 2005 and 2015. Data have been sourced from unconsolidated financial statements. Institution-specific characteristics appear as one-year lagged variables in all specifications. The bank levy (BL) is represented by a dummy variable indicating 1 for all years the levy applies to, and zero for all remaining years. Robust standard errors that control for clustering at the financial institution level are reported in brackets

Variables	German and Hungarian credit institutions					
	net interest margin (%)	net interest margin (%)	net interest income (ln)	net interest income (ln)	net fees and commissions revenues (ln)	net fees and commissions revenues (ln)
	(1)	(2)	(3)	(4)	(5)	(6)
Efficiency	5.00e-05	5.03e-05	-0.000841*	-0.000850*	-0.000583	-0.000586
	(0.000370)	(0.000371)	(0.000489)	(0.000497)	(0.000358)	(0.000366)
GDP growth	0.00139	0.00121	-0.0111***	-0.0122***	0.00553**	0.00437*
	(0.00303)	(0.00304)	(0.00317)	(0.00320)	(0.00240)	(0.00239)
Inflation	0.0317***	0.0322***	-0.0288***	-0.0248**	-0.0348***	-0.0308***
	(0.00828)	(0.00830)	(0.0105)	(0.0106)	(0.00975)	(0.00969)
Capital Ratio	0.0131***	0.0130***	0.00480	0.00514	0.000645	0.000780
	(0.00378)	(0.00376)	(0.00493)	(0.00502)	(0.00406)	(0.00407)
Credit Risk	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Liquidity Risk	-0.166**	-0.166*	-0.365**	-0.363**	-0.164	-0.161
	(0.0847)	(0.0848)	(0.144)	(0.145)	(0.103)	(0.103)
Size	0.00114	0.000956	0.0428***	0.0430***	0.0227**	0.0222**
	(0.0102)	(0.0102)	(0.0133)	(0.0134)	(0.0107)	(0.0107)
BL	-0.142***	-0.143***	0.390***	0.387***	0.0751***	0.0711***
	(0.0376)	(0.0379)	(0.0360)	(0.0363)	(0.0218)	(0.0219)
BL * Total Asset		0.000		0.000		0.000
		(0.000)		(0.000)		(0.000)
Constant	0.664***	0.665***	10.701*	10.69***	11.46***	11.45***
	(0.153)	(0.153)	(0.239)	(0.241)	(0.214)	(0.214)
Number of obs.	1,842	1,842	1,842	1,842	1,840	1,840
R-squared	0.0564	0.0558	0.224	0.301	0.0956	0.215

Symbols *, **, *** represent statistical significance at the level of 10%, 5%, and 1%, respectively.

Source: own calculations.

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Table 7. Data presenting estimates based on GLS regressions with a random effect on Hungarian credit institutions in 2008-2015. Data have been sourced from unconsolidated financial statements. Institution-specific characteristics appear as one-year lagged variables in all specifications. The bank levy (BL) is represented by a dummy variable indicating 1 for all years the levy applies to, and zero for all remaining years. Robust standard errors that control for clustering at the financial institution level are reported in brackets

Variables	Hungarian credit institutions					
	net interest margin (%)	net interest margin (%)	net interest income (ln)	net interest income (ln)	net fees and commissions revenues (ln)	net fees and commissions revenues (ln)
	(1)	(2)	(3)	(4)	(5)	(6)
Efficiency	0.001	0.001	0.001***	0.001***	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
GDP growth	0.070	-0.070	-0.150	0.080	-0.30*	-0.23*
	(0.520)	(0.490)	(0.110)	(0.090)	(0.180)	(0.130)
Inflation	-0.010	-0.180	-0.190*	-0.12	-0.440	-0.36**
	(0.600)	(0.550)	(0.110)	(0.090)	(0.210)	(0.160)
Capital Ratio	-0.020	0.010	0.010	-0.010	0.010	-0.020
	(0.020)	(0.020)	(0.010)	(0.010)	(0.020)	(0.010)
Credit Risk	-3.530	-2.580	0.330	0.110	-0.070	0.050
	(4.250)	(3.120)	(0.530)	(0.730)	(0.750)	(0.510)
Liquidity Risk	2.170	1.470	0.330	0.120	0.720	0.130
	(3.180)	(2.580)	(0.280)	(0.470)	(0.620)	(0.480)
Size	-0.400	-0.230	0.230	0.040	0.290	0.080
	(0.290)	(0.190)	(0.250)	(0.170)	(0.340)	(0.190)
BL	-0.540	17.13*	1.320*	-8.070***	2.04*	-10.66***
	(3.090)	(9.080)	(0.750)	(2.990)	(1.200)	(4.130)
BL * Total Asset		-0.850**		0.460***		0.610***
		(0.420)		(0.150)		(0.210)
Constant	2.190	10.206*	0.388*	2.420*	1.430*	9.53*
	(7.022)	(4.665)	(0.154)	(0.130)	(0.909)	(0.797)
Number of obs.	154	154	154	154	154	154
R-squared	0.126	0.053	0.005	0.679	0.002	0.788

Symbols *, **, *** represent statistical significance at the level of 10%, 5%, and 1%, respectively.
Source: own calculations.

Table 8. Data presenting estimates based on GLS regressions with a random effect on German credit institutions in 2005–2015. Data have been sources from unconsolidated financial statements. Institution-specific characteristics appear as one-year lagged variables in all specifications. The bank levy (BL) is represented by a dummy variable indicating 1 for all years the levy applies to, and zero for all remaining years. Robust standard errors that control for clustering at the financial institution level are reported in brackets

Variables	German credit institutions					
	net interest margin (%)		net interest income (ln)		net fees and commissions revenues (ln)	
	(1)	(2)	(3)	(4)	(5)	(6)
Efficiency	0.019	-0.001	-0.150	-0.002	0.0120	-0.001
	(0.082)	(0.001)	(0.119)	(0.001)	(0.101)	(0.001)
GDPgrowth	0.397	-0.004	1.443***	-0.011***	0.715***	-0.001
	(0.557)	(0.003)	(0.421)	(0.003)	(0.228)	(0.002)
Inflation	0.655	0.033***	1.862***	-0.033***	-7.704***	-0.032***
	(0.679)	(0.012)	(0.508)	(0.010)	(2.452)	(0.008)
Capital Ratio	-0.060	-0.244	0.026	-0.111	0.626	0.010
	(0.267)	(0.204)	(0.517)	(0.319)	(0.517)	(0.145)
Credit Risk	0.001	0.001	-0.001	0.001	0.001*	0.001*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Liquidity Risk	-0.293*	-0.346***	-0.620***	-0.441***	-0.486***	-0.390**
	(0.161)	(0.090)	(0.214)	(0.170)	(0.160)	(0.157)
Size	-0.026**	-0.027**	0.115***	0.126***	0.050***	0.047***
	(0.012)	(0.011)	(0.031)	(0.024)	(0.012)	(0.011)
BL	0.027	-0.119***	0.937***	0.351***	3.419***	0.095***
	(0.186)	(0.043)	(0.135)	(0.038)	(1.071)	(0.027)
BL*Relevant Liabilities		-0.001		0.001*		0.001*
		(0.001)		(0.001)		(0.001)
Constant	-0.123	1.050***	5.307***	8.918***	20.140***	10.10***
	(1.272)	(0.182)	(1.231)	(0.361)	(3.092)	(0.196)
Number of obs.	1,714	1,712	1,714	1,712	1,315	1,315
R-squared	0.166	0.205	0.250	0.399	0.351	0.384

Symbols *, **, *** represent statistical significance at the level of 10%, 5%, and 1%, respectively.
Source: own calculations.

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Interestingly, the results presented in Table 6 show that while BLs has, on average, negatively impacted the net interest margin, it seems to have a positive effect on the absolute values of net interest income, as well as on fees and commissions. It seems to indicate that banks have passed their levy costs on to their customers by charging higher rates for their products. Interestingly, these higher costs seem to occur in both the interest and the non-interest business. At the same time, probably German banks have increased the deposit rate to encourage more levy-exempted deposits which decreased banking margin. This kind of behavior has been also documented by Buch et al. (2016). These results confirm the existing pass-through theory (Albertazzi & Gambacorta, 2010; Huizinga et al., 2012; Buch et al., 2016; Haskamp, 2018).

Conclusions based on the whole panel are also supported by the regression results on individual countries. However, we additionally notice that the results also depend on the size of institutions, as suggested by the interaction terms in both Table 7 and Table 8.

In line with our theory, the pass-through effect is hardly achievable for smaller and more specialized institutions in Hungary. We also notice that the interest margin – although higher after levy introduction – shows a smaller increase at smaller institutions than at larger ones. This is shown by the interaction coefficient with the margin at specification (2) of Table 7. Moreover, it can be seen that absolute revenues from both interest and non-interest business decreased, when controlling for the size of banks. These results indicate that revenues tend to decrease more at smaller banks; this means that higher cost of banking services has generated a negative effect on the business activities of smaller banks in Hungary. All our interaction variables are highly statistically significant.

Interestingly, the results for German banks provide different conclusions. They show that both net income and fees and commissions increase significantly after the levy introduction, which clearly indicates the pass-through effect in German banks. Interestingly, we notice that this effect is especially visible at bigger banks, as both the levy variable and the size interaction variable have positive signs. As discussed, larger banks are in a better position to pass the costs of different regulatory burdens to their customers, due to their greater market power and more diversified structure. Similarly, as it can be seen in the aggregate regression (Table 5), we notice that the net interest margin in relation to banks' assets decrease at German banks. This result seems to be an effect of increasing deposit rates due to the deposit exemption from levy payment (Buch et al., 2016).

Considering the impact of other variables, most of them indicate similar signs as in the previous regressions. All of them seem to be in line with our expectations.

The effect of BL design on banks' portfolio structure

The effect of BL on lending

In line with existing studies, we argue that the introduction of BLs may influence banks' business; this influence may occur in three ways. First, banks burdened by additional costs could be forced to limit their lending activity to reduce their tax burden. This effect may be more noticeable in Hungary where the whole asset side of banks is being taxed and banks have limited opportunities to pass their costs on to their customers due to the long-term nature of assets, smaller sizes, and the limited scope of their activities. Molyneux et al. (2020) document that low interest rates specifically negatively affect the profits and margins of smaller, more 'interest-oriented' business models as well as specialists in real estate and mortgage products. Second, banks may try to move their portfolio into levy-exempted products. In both countries, the levy design assumes the exemption of specific asset (liability) positions. Therefore, it can be expected that banks might make such a shift in their balance sheets to decrease their tax burden. Empirically, Merz and Overesch (2016) as well as Buch et al. (2016) support this hypothesis by showing that banks make changes in their portfolios towards products with a lower tax burden. This effect should be more visible in Germany, as regulators allow for more exemptions than in Hungary. Third, banks may also replace lower margin products with higher margin products to offset their tax burden, thereby improving their profitability. This behavior by banks – restructuring their balance sheet as a response to changes in tax rules – has been documented, for example, by King (2013) or Rajan (1995), Weistroffer (2013), Roengpitya et al. (2014).

To verify these three effects, we regress the levy variable on three different specifications. First, we regress the levy variable on banks' loan activity and present the results in Table 9 for Hungary and in Table 10 for Germany.

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Table 9. Data presenting estimates based on GLS regressions with a random effect on Hungarian credit institutions in 2008–2015. Data have been sourced from unconsolidated financial statements. Institution-specific characteristics appear as one-year lagged variables in all specifications. The bank levy (BL) is represented by a dummy variable indicating 1 for all years the levy applies to, and zero for all remaining years. Robust standard errors that control for clustering at the bank level are reported in brackets

Variables	Hungarian credit institutions					
	Loans Growth		Loans to total asset		Loans (ln)	
	(1)	(2)	(3)	(4)	(5)	(6)
Efficiency	0.001	0.001	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
GDP Growth	-0.005	-0.005	-0.002	-0.002	-0.023***	-0.023***
	(0.009)	(0.009)	(0.002)	(0.002)	(0.009)	(0.009)
Inflation	0.020*	0.020*	0.004	0.004	-0.070***	-0.070***
	(0.011)	(0.011)	(0.004)	(0.004)	(0.019)	(0.019)
Capital Ratio	0.002	0.002	0.001	0.001	-0.006	-0.006
	(0.002)	(0.002)	(0.001)	(0.001)	(0.008)	(0.008)
Credit Risk	-0.000	-0.000	0.000	0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Liquidity Ratio	0.101	0.100	-0.068	-0.078	-0.430	-0.443
	(0.109)	(0.110)	(0.090)	(0.090)	(0.628)	(0.638)
Size	-0.002	-0.002	-0.00108	-0.001	-0.008	-0.008
	(0.003)	(0.004)	(0.002)	(0.002)	(0.020)	(0.020)
BL	-0.053	-0.050	0.018	0.036	0.386**	0.408*
	(0.063)	(0.064)	(0.033)	(0.036)	(0.180)	(0.210)
BL*Total Asset		-0.000		-0.002*		-0.000
		(0.000)		(0.005)		(0.000)
Constant	0.030	0.037	0.573***	0.569***	17.24***	17.23***
	(0.070)	(0.067)	(0.043)	(0.043)	(0.612)	(0.614)
Number of obs.	243	243	243	243	243	243
R-squared	0.069	0.064	0.009	0.063	0.207	0.209

Symbols *, **, *** represent statistical significance at the level of 10%, 5%, and 1%, respectively.
Source: own calculations.

Table 10. Data present estimates based on GLS regressions with a random effect on German credit institutions in 2005–2015. Data have been sourced from unconsolidated financial statements. Institution-specific characteristics appear as one-year lagged variables in all specifications. The bank levy (BL) is represented by a dummy variable indicating 1 for all years the levy applies to, and zero for all remaining years. Robust standard errors that control for clustering at the bank level are reported in brackets

Variables	German credit institutions					
	Loan Growth		Loan to Assets		Loan(ln)	
	(1)	(2)	(3)	(4)	(5)	(6)
Efficiency	-1.536	-1.549	-0.001**	-0.001**	0.001	0.001
	(1.049)	(1.054)	(0.001)	(0.001)	(0.001)	(0.001)
GDP Growth	-13.340	-13.35	0.001	0.001	0.003	0.003
	(14.800)	(14.79)	(0.001)	(0.001)	(0.003)	(0.003)
Inflation	27.780	27.81	0.098***	0.098***	-0.010	-0.012
	(20.620)	(20.71)	(0.006)	(0.006)	(0.020)	(0.020)
Capital Ratio	4.618*	4.637*	-0.345***	-0.345***	-0.274	-0.268
	(2.802)	(2.812)	(0.111)	(0.111)	(0.511)	(0.513)
Credit Risk	0.000	0.000	-0.001	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Liquidity Ratio	-2.496	-2.554	-0.128***	-0.127***	-0.703**	-0.707**
	(1.925)	(1.968)	(0.044)	(0.044)	(0.320)	(0.320)
Size	-0.550*	-5.675*	-0.009**	-0.009**	0.131***	0.132***
	(30.38)	(31.28)	(0.004)	(0.004)	(0.040)	(0.040)
BL	-0.726*	-0.727*	-0.362***	-0.361***	0.080*	0.074*
	(0.391)	(0.392)	(0.013)	(0.013)	(0.043)	(0.043)
BL*Relevant Liabilities		0.000		0.000***		0.000***
		(0.000)		(0.000)		(0.000)
Constant	6.708	6.974	0.632***	0.632***	12.070***	12.050***
	(4.186)	(4.312)	(0.065)	(0.065)	(0.630)	(0.629)
Number of obs.	1,588	1,588	1,599	1,599	1,593	1,593
R-squared	0.188	0.188	0.596	0.595	0.600	0.362

Symbols *, **, *** represent statistical significance at the level of 10%, 5%, and 1%, respectively.

Source: own calculations.

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Second we use the Hungarian sample to determine the changes in banks' asset activities. To this end, we regress the levy on: (i) other earning asset to total assets and (ii) absolute size of other earnings asset (ln). The latter variable includes financial investment like government bonds, derivatives and other off-balance sheet activities. We expect to observe that Hungarian banks move their activities into higher margin products to improve their profitability, burdened by the levy payments. If this supposition is supported, we will observe a positive effect of BL on other earnings assets. Table 12 presents the regression results on Hungarian sample. Similar to the previous cases, we include in all our regressions the interaction of levy variable with the size of banks to distinguish a non-linear effect dependent on the size of the institutions. We expect that larger banks would be less inclined to reduce or change their operations due to a lower scale and scope of their business. Third, we test how the levy introduction has affected the change in the source of funding at German banks. To this end, we regress our tax variable on: (i) customer deposit growth, (ii) deposit-to-asset ratio, and (iii) customer deposit (ln). We should see a positive and statistically significant effect of the tax variable on these variables, due to the nature of the levy exemption. We present the regression results in Table 12.

Table 11. Data presenting estimates based on GLS regressions with a random effect on Hungarian credit institutions in 2008-2015. Data have been sourced from unconsolidated financial statements. Institution-specific characteristics appear as one-year lagged variables in all specifications. The bank levy (BL) is represented by a dummy variable indicating 1 for all years the levy applies to, and zero for all remaining years. Robust standard errors that control for clustering at the bank level are reported in brackets

Variables	Hungarian credit institutions			
	other earning asset to total assets		other earning assets (ln)	
	(1)	(2)	(3)	(4)
Efficiency	0.001	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
GDP Growth	0.001	0.001	-0.018**	-0.019**
	(0.003)	(0.003)	(0.008)	(0.009)
Inflation	0.001	0.001	-0.078***	-0.075***
	(0.005)	(0.005)	(0.022)	(0.022)
Capital Ratio	0.001	0.001	0.001	-0.002
	(0.001)	(0.001)	(0.007)	(0.007)

Credit Risk	-0.001	-0.001	-0.000	-0.000
	(0.001)	(0.001)	0.000)	(0.000)
Liquidity Ratio	0.028	0.035	-0.151	-0.086
	(0.082)	(0.081)	(0.336)	(0.353)
Size	0.002	0.002	0.0039	0.008
	(0.003)	(0.003)	(0.015)	(0.015)
BL	-0.005	-0.020	0.472***	0.396***
	(0.030)	(0.032)	(0.131)	(0.150)
BL* Total Asset		0.003**		0.000
		(0.001)		(0.000)
Constant	0.346***	0.348***	17.240***	0.346***
	(0.045)	(0.045)	(0.612)	(0.045)
Number of obs.	237	237	237	237
R-squared	0.027	0.034	0.227	0.2159

Symbols *, **, *** represent statistical significance at the level of 10%, 5%, and 1%, respectively.
Source: own calculations.

Table 12. Data presenting estimates based on GLS regressions with a random effect on German credit institutions in 2005-2015. Data have been sourced from unconsolidated financial statements. Institution-specific characteristics appear as one-year lagged variables in all specifications. The bank levy (BL) is represented by a dummy variable indicating 1 for all years the levy applies to, and zero for all remaining years. Robust standard errors that control for clustering at the bank level are reported in brackets

Variables	**German credit institutions**					
	Deposit Growth		**Deposit to Assets**		**Deposit (ln)**	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Efficiency	5.327	5.135	0.001	0.001*	-0.000	-0.001
	(4.125)	(4.019)	(0.001)	(0.001)	(0.001)	(0.001)
GDP Growth	0.580	0.578	-0.001	-0.001	-0.008*	-0.007*
	(0.617)	(0.6205)	(0.001)	(0.001)	(0.004)	(0.004)
Inflation	-0.740	-0.602	-0.006**	-0.006**	0.004	-0.001
	(0.640)	(0.635)	(0.003)	(0.003)	(0.013)	(0.013)

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Capital Ratio	-12.538	-12.427	-0.054	-0.054	0.051	0.059
	(7.908)	(7.797)	(0.055)	(0.055)	(0.198)	(0.198)
Credit Risk	-0.001	-0.003	0.000	0.000	0.000	0.000
	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Liquidity Ratio	1.261	1.134	0.052	0.054	0.107	0.071
	(9.002)	(8.153)	(0.038)	(0.038)	(0.214)	(0.215)
Size	2.757*	2.379*	-0.006*	-0.005*	0.078***	0.079***
	(1.492)	(1.290)	(0.003)	(0.003)	(0.0271)	(0.027)
BL	2.363	2.770**	0.058***	0.059***	0.287***	0.271***
	(1.520)	(1.506)	(0.007)	(0.008)	(0.046)	(0.047)
BL*Relevant Liabilities		-0.000***		-0.000		0.000
		(0.000)		(0.000)		(0.000)
Constant	-3.936*	-1.538	0.646***	0.640***	12.61***	12.60***
	(2.170)	(1.031)	(0.051)	(0.0510)	(0.430)	(0.421)
Number of obs.	1,599	1,599	1,599	1,599	1,599	1,599
R-squared	0.140	0.129	0.151	0.151	0.345	0.362

Symbols *, **, *** represent statistical significance at the level of 10%, 5%, and 1%, respectively.
Source: own calculations.

The regression results shown above present interesting implications. Surprisingly, they verify that while in Hungary, banks' activities have not been severely impacted by the levy, a significant decrease occurred in almost all loan measures in Germany. More interestingly, in Hungary, we even observe a slight increase in the loan volume due to the levy introduction and no effect depending on the size of the institutions, all else being constant. Conversely, we see that in Germany, almost all loan measures were negatively affected by the levy. The only slight increase is in the absolute loan volume; however, the effect is barely statistically significant. We observe that the effect is more severe among smaller banks, for which the ratio of loan to total asset decreases significantly as a result of the levy introduction. This is not surprising, as smaller banks who specialize in lending activity might suffer more from the levy introduction than larger and more diversified banks. Higher costs and lower margins might discourage these banks from further lending expansion.

Interestingly, the estimation results presented in Tables 11 and 12 show that banks try to restructure their business to avoid or to diminish the tax burden. They seem to suggest that banks either shift their positions into levy-exempted products (for example,

see the result on German sample in Table 11) or if this is not possible, they try to replace lower margin products with more profitable instruments. The latter can be seen in the Hungarian sample, where regulators do not allow for levy exemptions (Table 12). For all specifications presented in Tables 11 and 12, the levy impacts our variables significantly either by shifting the funding sources to levy-exempted deposits or into other, probably higher margin investment.

Robustness check

Fixed-effect models

Although our Hausman test pointed toward a random effect, some recent studies also use a fixed-effect estimator while investigating similar questions. Therefore, we re-estimate our results using the fixed-effect model to check the robustness of our estimations. Table 13 presents the regression results for the Hungarian sample, while Table 14 contains the German sample's results.

Table 13. Data presenting estimates based on the regressions with a fixed effect on Hungarian credit institutions in 2008-2015. Data has been sourced from unconsolidated financial statements. Institution-specific characteristics appear as one-year lagged variables in all. The bank levy (BL) is represented by a dummy variable indicating 1 for all years the levy applies to, and zero for all remaining years. Robust standard errors that control for clustering at the financial institution level are reported in brackets

Variables	Hungarian credit institutions					
	Profit before tax (ln)		Profit before tax to total assets		Return on assets	
	(1)	(2)	(3)	(4)	(5)	(6)
Efficiency	-0.001	-0.001	0.000	0.000	0.001	0.001
	(0.002)	(0.002)	(0.000)	(0.000)	(0.001)	(0.001)
GDP growth	0.254	0.018	0.001	0.001	0.007	0.011
	(0.275)	(0.023)	(0.001)	(0.001)	(0.041)	(0.040)
Inflation	0.225	-0.077*	0.001	0.001	0.044	0.040
	(0.251)	(0.038)	(0.001)	(0.001)	(0.068)	(0.068)
Capital Ratio	0.004	0.007	0.001	0.001	0.013	0.018*
	(0.012)	(0.011)	(0.001)	(0.001)	(0.010)	(0.010)

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Credit Risk	-6.534***	-5.990***	-0.193	-0.188	-14.910	-14.480
	(1.973)	(2.134)	(0.227)	(0.224)	(19.07)	(18.720)
Liquidity ratio	-0.400	-0.589	0.013	0.011	0.731	0.509
	(0.607)	(0.627)	(0.04)	(0.013)	(1.167)	(1.114)
Size	-0.014	-0.014	-0.001	-0.001	-0.057	-0.060
	(0.022)	(0.020)	(0.001)	(0.001)	(0.042)	(0.041)
BL	1.115	0.061	-0.004	-0.001	-0.360	0.032
	(0.821)	(0.300)	(0.005)	(0.006)	(0.472)	(0.528)
BL*Total Asset		-0.001**		-0.000**		-0.001*
		(0.000)		(0.003)		(0.000)
Constant	15.090***	13.03***	0.023***	0.0232***	1.992***	1.978***
	(0.244)	(1.732)	(0.005)	(0.00529)	(0.451)	(0.474)
Number of obs.	201	201	243	243	243	243
R-squared	0.225	0.738	0.110	0.722	0.006	0.035

Symbols *, **, *** represent statistical significance at the level of 10%, 5%, and 1%, respectively.
Source: own calculations.

Table 14. Data presenting estimates based on the regressions with a fixed-effect on German credit institutions in 2005–2015. Data have been sourced from unconsolidated financial statements. Institution-specific characteristics appear as one-year lagged variables in all specifications. The bank levy (BL) is represented by a dummy variable indicating 1 for all years the levy applies to, and zero for all remaining years. Fixed standard errors that control for clustering at the financial institution level are reported in brackets

Variables	**German credit institutions**					
	Profit before tax (ln)		**Profit before tax to total assets (%)**		**Return on assets**	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Efficiency	-0.001	-0.001	-0.001	-0.001	0.011	0.011
	(0.002)	(0.002)	(0.001)	(0.001)	(0.013)	(0.013)
GDP growth	-1.679*	-1.723*	-0.364	-0.360	-2.715	-2.720
	(0.927)	(0.943)	(0.344)	(0.346)	(5.044)	(5.077)
Inflation	-2.160**	-2.214**	-0.421	-0.412	-2.561	-2.553
	(1.094)	(1.114)	(0.401)	(0.404)	(6.234)	(6.277)

Capital Ratio	-0.574	-0.498	-0.316**	-0.314**	-2.206	-2.208
	(0.689)	(0.697)	(0.145)	(0.143)	(2.325)	(2.329)
Credit Risk	0.000	0.000	-0.000	-0.000	-0.000*	-0.000*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Liquidity ratio	-0.457	-0.511*	-0.161**	-0.154**	-0.522	-0.456
	(0.284)	(0.286)	(0.076)	(0.076)	(2.422)	(2.421)
Size	0.148***	0.028***	-0.009	-0.007	0.508*	0.522*
	(0.002)	(0.002)	(0.009)	(0.009)	(0.267)	(0.267)
BL	-0.578*	-1.723*	-0.151*	-0.143*	-3.357*	-3.335*
	(0.253)	(0.028)	(0.078)	(0.078)	(1.789)	(1.795)
BL*Relevant Liabilities		0.000		-0.001**		-0.000
		(0.000)		(0.000)		(0.000)
Constant	11.140***	11.060***	1.577**	1.534*	13.734	1.161
	(2.163)	(2.205)	(0.797)	(0.797)	(14.394)	(12.83)
Number of obs.	1,619	1,619	1,725	1,725	1,766	1,725
R-squared	0.513	0.499	0.007	0.012	0.027	0.028

Symbols *, **, *** represent statistical significance at the level of 10%, 5%, and 1%, respectively.
Source: own calculations.

The regression results of the fixed-effect model do not differ significantly from our baseline estimations. In both cases, we find a significant and negative impact of levy on banks' profits; however, the statistical magnitude is weaker. Similarly, the results indicate that the effects depend on the size of banks; this effect is more significant in Germany than in Hungary.

Difference-in-differences

As an alternative robustness analysis, we use the difference-in-differences technique. Additionally, we also replace banks' performance measures by alternative ones, such as a loss dummy (Loss_D), which is a dummy variable of 1 if a bank reports a loss in a given year and 0 otherwise. We also replace ROA with return on equity (ROE). ROE is often used in the literature as an alternative to ROA to measure bank's profitability.

To estimate the effect of the BL on credit institutions in both Germany and Hungary, we follow the approach of Buch et al. (2016) and Capelle-Blancard and Havrylchyk (2017) . We exploit this exogenous policy change from the perspective of an individual

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bank to distinguish between the behavior of banks that paid the levy (the "treated" banks) and those who did not (the "control" group). Further, we focus on differences in the banks' behavior before (2008–2010 for Germany and 2008–2009 for Hungary) and after (2011 for Germany and 2010 for Hungary) the introduction of the levy. This allows us to isolate the effect of the levy. It must, however, be noted that the results should be treated with caution. The difference-in-differences technique assumes that the non-treated group is similar in nature to the treated group (Abadie, 2005). However, banks exempted from the levy were smaller local banks (Buch et al., 2016) which makes the comparison toward international commercial banks much more difficult.

Table 15 outlines the regression results of the entire sample, including all credit institutions in the German and Hungarian banking sectors. We present estimation results on profitability measures such as dummy variable Loss_D, ROE, and ROA.

Table 15. Data presenting estimates based on difference-in-difference model for German and Hungarian credit institutions in 2005—2015. Data have been sourced from unconsolidated financial statements. Institution-specific characteristics appear as one-year lagged variables in all specifications. Loss _ D is a dummy variable indicating 1 if a bank has a loss in a given year, and zero otherwise

Variables	German and Hungarian credit institutions					
	Loss_D		Return on Equity		Return on assets	
	(1)	(2)	(3)	(4)	(5)	(6)
Efficiency	0.000	0.000	-0.0134	-0.009	0.002	0.003
	(0.001)	(0.001)	(0.0106)	(0.010)	(0.006)	(0.006)
GDP growth	0.001	0.001	0.0115	0.026	-0.182	-0.178
	(0.002)	(0.002)	(0.103)	(0.103)	(0.126)	(0.126)
Inflation	0.006	0.006	0.277	0.267	0.253*	0.256*
	(0.007)	(0.005)	(0.407)	(0.405)	(0.153)	(0.154)
Capital Ratio	0.002	0.001	0.260	0.358	-0.097***	-0.093***
	(0.002)	(0.001)	(0.244)	(0.243)	(0.031)	(0.029)
Credit Risk	0.001	0.001**	-0.000	-0.000	-0.000***	-0.000***
	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Liquidity ratio	0.180***	0.173***	-1.148	-0.578	-0.479	-0.130
	(0.048)	(0.034)	(1.470)	(1.486)	(1.347)	(1.344)

Size	0.002	-0.001	-0.122	0.048	0.311***	0.441***
	(0.004)	(0.002)	(0.134)	(0.142)	(0.085)	(0.113)
BL	0.028*	-0.092	-1.194*	9.918*	-2.995***	2.970*
	(0.015)	(0.062)	(0.629)	(5.593)	(0.523)	(1.575)
BL*Total Asset		0.008**		-0.716*		-0.388***
		(0.004)		(0.376)		(0.108)
Constant	-0.027	0.014	6.559***	3.682*	-0.208	-2.242
	(0.048)	(0.038)	(1.987)	(1.937)	(1.073)	(1.490)
Number of obs.	1,842	1,842	1,672	1,672	1,842	1,842
R-squared	0.034	0.036	0.013	0.019	0.018	0.020

Symbols *, **, *** represent statistical significance at the level of 10%, 5%, and 1%, respectively.
Source: own calculations.

Our regression results prove our baseline outcomes and clearly point towards BL having a negative effect on banks' profitability. This outcome suggests that the introduction of BL negatively affects both the absolute profits and the profitability measures. Similarly, as in our previous regressions, the results suggest that the effect seems to be non-linear and dependent on the size of institutions. It seems that the burden of the levy weighs more heavily on larger banks than on smaller institutions. However, as mentioned before, caution should be taken when interpreting results, as the sample is dominated by German banks, which are larger by nature and because the country has progressive taxation.

Conclusions

During the last two decades, the global financial sector has experienced major transformations in its operating environment. One such change was the introduction of BLs in nearly all European countries. The main aim of introducing BLs was to change the incentives of banks' management and owners toward risk behavior. However, a new banking taxation might also have a significant negative impact on the performance and business activities of the sector. This topic seems timely due to the potential distress of banking sectors across the world as a result of the COVID-19 pandemic. The levy might further weaken banking sector, postponing the recovery process of economies.

This study empirically investigates the effects of the BL on banks' profitability as well as their activities, based on credit institutions' experience in two different countries

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– Germany and Hungary – during the period 2005–2015. The choice of these two countries is not random. Both countries have introduced BL around similar time periods. However, their levy schemes differ significantly from one another. While Hungary chose to tax banks' assets with virtually no balance sheet exemptions, Germany introduced a levy on banks' liabilities, allowing for significant avoidance for bank deposits. This article raises four important questions: 1) What is the effect of BLs on banks' profitability? 2) Do banks pass the costs of the levy on to their customers? 3) Do banks limit their credit activities as a result of the additional tax burden? 4) Do banks modify their business models to reduce the tax burden? An important contribution of our study is our analysis of the differential effects of the introduction of BLs on banking sector performance and activities, depending on the levy scheme. The results of the analysis will help us to determine the weakness of individual solutions and find a superior solution.

Our results show that the levy has a significant negative impact on banks' profitability. Importantly, this effect depends on neither the levy scheme nor the bank's size. The regression results on individual countries, however, illustrate that Hungarian banks were affected more severely by the introduction of BLs than German banks. One of the reasons seems to be large scale taxation in Hungary that covers virtually the entire asset side of banks' balance sheet, whereas in Germany, the scale was much smaller and included significant exemptions. We also noted that German banks were more likely to pass the cost of the levy on to the customers than Hungarian banks. This is because their bigger scale of operation and more diversified structure allows them to achieve a greater flexibility than at smaller and more specialized institutions, which dominate the banking sector in Hungary. This confirms the introduction of BLs had a weaker impact on the performance of the German banking sector than on the Hungarian one. In contrast, however, we also document that lending activity at German institutions is affected more than at Hungarian institutions. This result is interesting, as we expected that the asset levy will cause a greater drop in lending activity aimed at reducing the tax burden. We argue, however, that higher funding costs, and resultantly lower margins, discourage banks from additional lending. This result is in line with Buch et al.'s (2016) findings. Finally, our results show that banks generally try to restructure their business as a result of levy introduction. While German banks increase their deposit base, Hungarian banks extend their activities to non-interest and probably higher margin products.

Our empirical findings have several implications for policy makers. Our findings illustrate that BLs weaken the banking sector's performance and may therefore be especially dangerous during turbulent times when the accumulation of capital is

highly desired. Moreover, the findings indicate that the levy weakens the banking sector's activities. This may also translate into decreased economic growth. Moreover, we show that the levy reshapes banking business models. Regulators should definitely rethink the design of the levy and find a way to minimize the distortions in the banking sector. They should also consider a suspension or bank exemption from levy payments during turbulent times, such as the current international health crisis related to COVID-19.

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