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The Dark Side of the Bank Levy

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Abstract

We examine the consequences of imposing a high tax levy on bank assets. Employing unique supervisory bank-level data, we exploit different channels through which the new tax may impair the stability of the banking sector. We find that following the introduction of the levy, banks increase the cost of loans and decrease their overall availability to the real economy. We also document that changes in banks' loan portfolios are strongly related to bank-specific profitability and capital adequacy ratios. Furthermore, our evidence supports the view that banks engage in risk shifting by increasing the risk level of their loan portfolios, attempting to recover from the lower return on equity as the tax reduces their overall profits.

JEL Classification codes: G21, H22, L13

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1. Introduction

The global financial crisis of 2007-2008 caused significant economic damage worldwide and brought to public attention the relationship between banks' risk-taking, moral hazard and financial stability. To minimize the probability and scale of future crises, regulators across the globe have introduced a number of reforms on the financial system and International organizations, such as the International Monetary Fund, World Bank, European Commission, and Basel Committee, have issued various recommendations on banking regulations. Among the regulatory reforms and policy recommendations are special taxes levied on financial institutions, especially banks, to deter moral hazard in the banking sector and promote financial stability (IMF, 2010; Cannas et al., 2014). The belief is that a bank tax may help limit banks' incentive for risky operations, such as granting riskier loans on the asset side and relying more on short-term funding sources on the liability side. As proponents contend, a bank levy would reduce the benefit to banks from growing assets, diminishing their incentive to fuel growth with borrowed funds and thereby reducing the vulnerability of the banking sector. For example, such a levy is cited as a macroprudential policy tool regulators could deploy to tame excessive credit or house price growth (Claessens, 2015; Budnik and Kleibl, 2018). A bank levy could also be designed as a Pigovian tax to deter certain activities of banks that would impose adverse externalities on the society at large (Perotti and Suarezb, 2011).

Of course, a new tax on banks may be attractive to a government by providing the government with another revenue source (Chaudhry et al., 2015). This aspect is particularly relevant as the recent Covid-19 health and economic crisis has significantly increased government budget deficits in affected countries. For example, Hungary introduced in May 2020 a Covid-19 emergency tax on banks, which is an additional one-off charge on top of the prevailing bank tax. More countries not surprisingly have also introduced or are seriously considering banking taxation to address their budgetary shortfalls.

Since the 2007-2008 financial crisis, 13 European Union countries have introduced some forms of bank levy. The specific forms including tax base and rates differ widely across the countries. The relative tax burden on the banking sector ranges from 0.7% of gross income in Germany to 9.4% in the Netherlands (Emter et al., 2019). Against this background, Poland introduced and implemented in 2016 a significant new tax levied on individual banks' assets. The amount of the tax collected is significant, equal to approximately 30% of the banks' earnings (NBP, 2016).

As countries (e.g., Poland, Romania and Lithuania) impose a significant new tax burden on the banking sector, banks and their supervisors have warned that the taxation could have unintended consequences on bank lending (ECB, 2019; IMF, 2019). Yet, only recently has a literature emerged to examine the implications of bank levy on financial intermediation services provided by banks to the real economy. Research suggests that banks might pass on their increased tax burden to customers by, for example, raising lending rates or imposing additional charges on services (Buch et al., 2016; Capelle-Blancard and Havrylchyk, 2017; Kogler, 2019). Such reactions of banks to higher taxation would negatively impact the spending of households and businesses that rely on bank credit to finance consumption and investments. A greater tax burden could also affect banks' loan supply by reducing their ability or propensity to extend credit (Buch et al., 2016). The negative effect on the demand for or the supply of bank credit would result in lower economic growth (Boscá et al, 2019).

In the post-crisis low interest rate environment, banks have been struggling with obtaining an acceptable return on equity (ROE). Additional taxes would damage banks' ability to achieve an adequate level of profits that allow for developing their business activities and fulfil their shareholders' expectations. It is recognized that to boost the ROE, banks may attempt to utilize the so-called risk-taking channel by increasing their business or financial risk (e.g., Neuenkirch and Nöckel, 2018). Thus, imposing an ad hoc bank levy to raise revenues for a budgetary

concern may have an unintended consequence of motivating greater risk taking by banks. This response of banks to the tax would make the banking sector more vulnerable to shocks and increase the likelihood of financial instability.

The debate notwithstanding, the implications of bank levy as a macroprudential or fiscal policy instrument have not been carefully examined. This may be due to a lack of uniformity on cross-border taxation policy, or due to a wide range of possible reactions by banks, which would depend on the specifics of the tax. In this paper, we hope to offer insights on this important issue. Our approach is to utilize a unique, disaggregated dataset (quarterly supervisory bank-level data for all commercial banks operating in Poland between 2007-2018) to study the reactions of banks to the implementation in 2016 of a new tax levied on certain assets of Polish banks. The granularity of this dataset allows us to distinguish between different categories of bank credit and to consider bank-level characteristics as potential sources of heterogeneous pass-through processes across banks. Our study focuses on changes in banks' lending dynamics, credit pricing, as well as potential risk shifting in response to the tax.

Poland is an ideal testing ground to study the effects of bank levy. The country has a developed economy which is the largest in Central and Eastern Europe (CEE). Its well-functioning banking sector plays a major role in providing credit to the real economy. Poland is among the few countries that have imposed a sectoral tax on the assets of banking institutions operating in the country. These institutions being highly levered, an asset-based tax, even with a small tax rate, can significantly increase their tax burden. Available data suggests that current tax burden on Polish banks is among the highest in the world (NBP, 2019). This high level of tax provides an excellent background to test the consequences of the bank tax. With a low level of bank tax, it might be difficult to discern changes in banks' behavior in response to the tax and the real impact of the tax to the economy. Given important policy implications, our study

of the Polish experience would offer insights to other countries contemplating a similar bank tax.

We find strong evidence that following the imposition of the new tax, banks change their lending behaviors on credit availability, credit margins, and the risk level of credit allocation. On credit availability, we find that banks reduce by approximately 0.7 percentage points (p.p.) the quarterly volume of loans to the non-financial private sector. Notably, the magnitude of this reduction depends also on certain characteristics of the bank. We show that banks with a low level of profitability (ROE) reduce by the most their lending to the real sector. In contrast, most other balance-sheet based characteristics have only a limited role in influencing the impact of the tax on credit retrenchment.

We also document a significant increase in credit margins (lending rate spreads) banks charge on all analyzed loan types. The baseline specification shows an increase of about 0.2 p.p. on banks' credit margins to the private sector, suggesting that banks pass on much of the new tax burden to their borrowers. Our findings of both loan volume contraction and credit margin expansion point to a significant distortion on banks' credit provision as a result of the tax levy. By making bank credit less available and more expensive to households and businesses that rely on it as source of funding, the new tax appears to have serious implications for the real economy.

Furthermore, we detect banks' behavior that is consistent with risk shifting in response to the tax levy. We find that with the tax being in place, banks reduce by more the supply of mortgage loans than that of higher-risk, higher-rate consumer or corporate loans. Controlling for the effective tax rate, we also observe that banks increase activities in the segment of consumer loans that are riskier. This evidence suggests that the bank tax may have an unintended consequence of motivating greater risk taking by banks and thereby making the banking sector riskier and less stable.

Our study contributes to the literature emerging recently to examine the pros and cons of bank tax. As in prior research (Blancard and Havrylchyk, 2017; Boscá et al, 2019), our results show that a bank tax raises the cost of financial intermediation services provided by banks and can lead to the distortion of their credit allocation. However, our analysis differs in several key aspects. First, we utilize a unique Polish supervisory dataset and document a significant impact of a tax levied on banks' assets on their lending activities. Poland is relatively large and open economy with developed financial sector, and as far as we know, a tax based on bank assets thus far has been implemented only in Poland and three other smaller countries (Hungary, Romania, and Slovenia).

More important, to the best of our knowledge, we are the first to investigate the specific effects of bank tax on the availability and margins of three main categories of bank loans – mortgage, consumer, and corporate loans. A granular analysis at the level of loan type allows us to uncover changes in banks' preferences for certain types of loans in the presence of the tax. Since each loan type exhibits a different risk profile, banks' changes of preferences – risk shifting – will affect the overall risk of their loan portfolios and therefore will have important implications for the stability of the banking sector. Thus, by formally testing for evidence of banks' risk shifting in response to a bank tax, our study makes an important contribution to the debate on relationship between bank taxes and financial stability. Prior research has offered no convincing theory or empirical evidence on risk shifting by banks as a response to the tax.

Our study contributes also to the literature on macroprudential regulations of banks. We examine the regulatory and systemic implications of using a bank tax as a policy tool, and document the significant consequences on bank credit, intended and unintended, of the Polish experience. The concerns raised in our study seem to be especially relevant and timely as a number of jurisdictions worldwide have been implementing or are seriously considering the implementation of similar taxation.

The rest of the paper is structured as follows. Section 2 provides an overview of bank levies in Europe. Section 3 reviews the related literature. Section 4 presents the stylized facts concerning the bank levy in Poland. Section 5 develops the main hypotheses. Section 6 explains the applied econometric approach and describes the data used in the regressions. Section 7 presents the regression results. In Section 8, we conclude. In the appendix, we provide more background information about the data set.

2. Overview of bank taxes in Europe

Table 1 presents a list of European Union countries that have introduced a sectoral tax on financial institutions, especially banks, since 2009. A main purpose of a bank tax is to help the country recover the costs of taxpayer support for banks during the financial crisis of 2007-2008. Another often-cited benefit of this tax is that it may help restrain undesirable activities in the banking sector. For example, to deter unwanted risky behavior, the tax base could be determined by the amount of unstable liabilities or by risk-weighted assets), and to strengthen the stability of the banking system, collected bank taxes could be allocated to recovery and resolution funds.

[Table 1 goes about here]

A banking sectorial tax was enacted in Poland on January 15, 2016 and took effect almost immediately afterward on February 1, 2016. The tax is levied on certain assets of financial institutions operating in Poland, such as commercial banks, other credit institutions and lending companies, as well as insurance companies. The tax is collected every month at a monthly rate of 0.0366% (an annual rate of 0.44%) on the value of a bank's taxable assets. The law excludes from tax base the value of the bank's Tier I and II capital and its holding of treasury securities. It also exempts from the tax state development banks and institutions in liquidation or recovery proceedings. The Polish government stated purpose of this tax is to raise additional revenues to

finance public expenditure. Nowhere was the tax referred to as a macroprudential policy instrument, or created to achieve specific macroprudential goals.

Although apart from Poland, only three other countries have levied a tax on banks' assets (see Table 1), a growing number of other European countries are considering adopting this or another form of tax. For example, Lithuania, a member of Eurozone, plans to impose as much as a 0.4% tax rate on banks' assets to help fund social spending. Spain proposes a tax on financial transitions in the banking sector, also to cover public spending. The Swedish government is making a fresh attempt to introduce a bank tax, this time to finance increased defense spending. All these examples suggest that bank taxes are increasingly accepted by European countries as a revenue source to address domestic spending needs.

This emphasis of bank taxes as a revenue source departs largely from the original idea of creating a taxation scheme to improve macroprudential regulations on banks. In fact, Hungary and Tunisia recently introduced temporary additional bank taxes to deal with their growing budget deficits due to the Covid-19 pandemic. The Hungarian move is particularly interesting since only a few years earlier, Hungary as well as Slovenia and United Kingdom chose to lower existing bank taxes, so as to improve banking profitability and motivate more lending. Although the Hungarian change of direction on taxing banks may reflected have the reality of great fiscal pressure, it may also have stemmed from a general lack of understanding on how such taxes may impact banks' providing credit to the real economy. Our study hopes to offer the evidence-based implications for policy considerations.

3. Literature review

Our study relates to several strands of the literature examining the impact of taxation on financial institutions. The earlier work focuses on how corporate income taxes (CITs) affect bank margins and leverage. Analyzing bank data from a large number of countries, Demirgüç-Kunt and Huizinga (1999, 2001), Chiorazzo and Milani (2011), and Albertazzi and Gambacorta

(2010) find that CITs are passed on to bank customers through increased net interest margins. Studies have also argued that higher corporate income tax rates motivate banks to increase leverage ratios because of the tax benefit of debt. For example, Keen and de Mooij (2012), Hemmelgarn and Teichmann (2014), and Gu et al. (2015) document a positive relationship between banks' leverage ratios and their CITs. Schandlbauer (2017) shows that an increase in the local U.S. state corporate income tax rate raises the non-depositary debt and also results in credit contraction in the balance sheets of tax-exposed banks. Bremus et al. (2020) find that the introduction of a bank levy on liabilities lowers banks' leverage as their liabilities become more expensive.

More closely related is research focusing specifically on the impacts of bank taxes on financial services provided by banks. Examining the effects of a bank levy in Germany, Buch et al. (2016) show that although the levy does not significantly affect loan supply or deposit rates on average, the most affected banks reduce lending and also increase lending rates as well as interest rates paid to new deposits. Similarly, Banerji et al. (2018) find that large Japanese banks affected by a tax on gross profits increase their net interest income and commissions while reducing loan volume, compared with unaffected banks. Boscá et al. (2019) provide evidence that banks respond to higher taxes by raising their markups and transferring part of the tax cost to firms and households via higher loan interest rates. Likewise, Kogler (2019) uses a cross-country panel dataset of EU banks to show that banks shift part of tax burden to their borrowers by moderately increasing the lending rates, although banks' depositors may benefit from a higher bank tax when deposits are partially exempt from the tax base. Emter et al. (2018) analyze cross-border flows and conclude that special bank taxes introduced in several EU countries are not significantly related to cross-border lending.

Closest in this literature to our work is perhaps, Capelle-Blancard and Havrylchyk's (2017) study of a Hungarian tax levied on bank assets. Analyzing the Hungarian experience, they find

that banks pass on a large fraction of the tax burden to their customers, particularly those with low demand elasticity such as households. They also examine the impact of this tax on banks' lending rates. However, they do not consider the effects of the tax on the availability of credit to the real sector and to various loan segments with different levels of risk. To the best of our knowledge, our study is the first to document that a tax levied on bank assets can result in not only a reduction in the overall availability of bank credit to the private sector, but also a change in the allocation of credit to loan segments, which cab have important implications for the level of risk in the banking sector and thus for financial stability.

Another closed related stream of research concerns risk taking or risk shifting by banks when facing monetary or regulatory policy shocks. Negative policy shocks are shown to make banks more willing to invest in risky assets (Jiménez et al., 2014, 2017; Acosta-Smith et al., 2018). Luo and Tanna (2014) suggest that the tax benefit of debt causes banks to prefer debt over equity financing and results in increased financial leverage and financial risk, potentially threatening financial stability. Devereux et al. (2019) find that bank levies in Europe cause banks to increase equity funding, but this reduction in financial risk on the liability side is offset by an increase in asset portfolio risk measured by the average risk weights on assets. Hryckiewicz et al. (2020) show that excluding government bonds from the tax base encourages banks to increase the share of these assets in their asset portfolio, exposing them to higher market and sovereign risk. Our study contributes to the literature by evaluating the short- and long-term effects of bank levy on banks' lending behavior, with a special emphasis on their subsequent choices of loan types. This emphasis on how banks respond to the levy by reallocating credit among various loans types with different risk profiles enables us to gain insights on possible risk shifting by banks, which are not be available in the prior studies.

Also related is the literature examining the efficacy of various macroprudential instruments and regulations. This research tends to focus primarily on instruments affecting the balance

sheet of financial institutions, which can be used to target systemic risk. Examples of the instrument identified to be an effective tool in limiting banks' excessive lending during booms and credit contraction during downturns include: debt service-to-income (DTI) ratios (Lim et. al., 2011; Dell'Ariccia et al. 2012), loan-to-value (LTV) ratios (Lim et. al, 2011; Wong et al. 2011; Cerutti et al., 2015; Morgan et al., 2019), capital requirements (Dell'Ariccia et al. 2012), dynamic provisioning (Jiménez et al., 2017), and reserve requirements (Dassatti et al., 2019).

Notably, the Global Macroprudential Policy Instruments Survey (Cerutti et al., 2017) indicates that taxes levied on financial activities are considered to be a macroprudential instrument. In fact, levies or taxes on financial institutions were used 22 times in Europe as a policy instrument (Budnik and Kleibl, 2018), and in most cases, they are imposed on the institutions' assets or liabilities rather than on financial activities. Cerutti et al. (2017) perform regression analyses to investigate various groups of individual macroprudential policies for overall credit growth. They argue that tax measures could have a dampening effect on credit growth in developing countries and on house prices in emerging markets. Dia and Van Hoose (2018) suggest that a tax on banking lending would deter excessive lending by reducing the returns from credit intermediation, although this approach could adversely affect loan quality.

While the Polish tax levied on bank asset has fiscal considerations in sight, the channels through which the levy affects banks' behavior do have much in common with macroprudential measures that affect banks' risk-return tradeoffs. Thus, the levy in Poland provides an excellent testing ground to examine how taxing bank assets may affect banks' provision of credit and their incentive for risk shifting. In this context, our paper extends the literature on macroprudential instruments by offering a unique assessment on the impact of the tax on risk taking in the banking sector and thus on financial stability.

4. Stylized facts of the impact of tax levy on banks

In this section, we provide stylized facts on the Polish bank levy as they form the basis for our hypotheses and empirical studies. In Panel A of Table 2, we show the evolution over time of our main variables of interest – lending rates and credit growth – and selected financial soundness indicators for the period between the fourth quarter of 2013 and 2018 (2013Q4 and 2018Q4). We apply two time intervals to distinguish the pre- and the post-introduction period based on the implementation of the tax in the first quarter of 2016 (2016Q1).

[Table 2 goes about here]

The introduction of a levy on the assets of banks and other financial institutions is a major development for the Polish financial services industry. By the end of 2018, 23 banks, controlling about 90% of the commercial banking sector's assets in Poland, have paid the bank tax. This sectoral tax is mainly responsible for an increase from 19% to 42% in banks' average effective corporate income tax (CIT) rate between 2016 and 2018. In this period, the ROE of Polish banks drops from 9.5% to 8.8%, deviating from the performance of its CEE country peers. The rapid deterioration of earnings outlook reduces the attractiveness of investment in Polish banks, resulting in a decline in the market valuations of banks and the holdings by foreign investors of banks' shares.[2]

During the 2016-2018 period, the average growth rate of banks' total assets decreases to 3.7% from 5.6% in the previous period of 2013-2015. The most noticeable change in the balance sheet of the overall banking sector is an increase in the share of government securities.

[2] The biggest decline in the market valuation of banks occurred in the fourth quarter of 2015, when the first announcements of the tax appeared. Concurrently, for the first time since 1999, the share of foreign investors dropped below domestic ones in the Polish banking sector. Due to the ownership changes, approx. 40% of the assets of the banking sector (an increase of 16 p.p. since the end of 2015) were under the direct or indirect control of the State Treasury, which actively participated in most of the acquisitions that took place after the tax reform (NBP, 2019).

In 2016, the year when the bank levy was introduced and implemented, the portfolio of government securities increased by approximately 34% year over year, much more than the increase of 3.9% in the value of loans. The shifts are attributable to optimization strategies around the bank levy since government securities are exempt from the new tax. Immediately after the introduction of the tax, the growth rate on loans for the non-financial sector slowed down. In the first year of its implementation in 2016, the lending growth rate declined to 5% from 7.7% in the prior year. However, we observe marked shifts in the lending behavior of banks. There were both a decline in credit spreads (Figure 1, right panel) and the relaxation of bank lending policy, at least in the initial years of the levy (Figure 2, left panel), on consumer loans that are characterized by higher profitability and greater credit risk.

[Figure 1 goes about here]

Opposite tendencies are observed on mortgage loans. The average annual growth rate on mortgage loans decreased to 2.3% in 2016–2018 from 5.9% in 2013–2015. This decrease was accompanied by increased credit margins and the tightening of criteria and conditions for granting mortgage loans. These changes in banks' lending dynamics suggest that banks may have attempted to compensate for the new tax burden by redirecting lending to more profitable and riskier segments of loans (e.g., consumer loans) and away from less profitable and safer mortgage loans.

[Figure 2 goes about here]

On lending to the corporate sector, the growth rate peaked in 2016 and subsequently stabilized at a lower level and there was a temporary increase in credit margins. However, it is generally difficult to ascertain the net effect of bank tax on the changes of lending dynamics. Banks may have increased credit spreads to pass on the cost of the new tax, which would negatively affect demand for loans. On the other hand, the decline in lending growth may be

due to declining corporate borrowing interest, as suggested by surveys of Polish companies at the time (NBP, 2019b).

To sum up, the stylized facts point to a decline in overall lending by Polish banks and an increase in their credit margins following the introduction of the bank levy in Poland. Also noticeable are other adjustments in banks' balance sheets, such as the greater reduction of certain loans, the change in loan structure, and the increased holding of tax-exempt government bonds. Some of these changes occurred a bit earlier in reaction to the announcement of the tax plan. All changes were taking place amid record low interest rates and generally very good economic conditions in the country.

5. Hypothesis development

In this section, we discuss various channels through which the bank levy would affect banks' credit volumes and lending rate margins. Our specific focus is on the demand and supply, the risk-taking, and the balance-sheet channel.

5.1 Demand and supply channel

Bank levies affect both the demand for and the supply of bank credit. On the demand side, simple logic behind the transmission mechanism suggests that in response to a new tax, banks would pass on much of the tax burden to borrowers by increasing interest rate margins on loans. The increased cost to the borrowers would diminish their propensity to borrow, resulting in a decrease in loan demand.

On the supply side, the linkage is a bit more subtle. Because of generally limited opportunities to renegotiate existing loan agreements, a new tax can lead to a substantial reduction in banks' profits, at least in the short term. All else the same, lower profits reduce banks' ability to generate capital from retained earnings or to raise capital by selling equity. Since an adequate level of capital is a key factor to bank credit growth, the diminished ability

to generate capital would hamper credit growth by banks. Furthermore, the reduced capital-generating ability raises concerns for financial stability and attracts greater regulatory scrutiny of the banking sector. As a result, banks may cut back lending to preserve capital adequacy. Banks may also choose to deleverage strategically by reducing more lending in market segments where the tax-adjusted rate of return on loans is considered to be below the target rate (Berlin, 2009).

The above arguments suggest that the levy would increase the borrowing cost of bank customers and would negatively affect the demand for and the supply of bank credit. Based on the demand and supply arguments, we formulate our first hypothesis as follows.

H1: The impact of the bank tax is negative on banks' credit growth but is positive on their loan spreads.

5.2 Risk-taking channel

Research has shown that banks adjust their balance-sheet components to circumvent the effects of regulations including tax changes (Borio and Zhu, 2014; Dia and Van Hoose, 2018; Devereux et al., 2019; Hryckiewicz et al., 2020). For example, exempting sovereign bonds from a tax base would make those bonds more attractive to banks, all else the same. Since a new levy would reduce banks' overall profitability and return to equity, banks may be tempted to engage in risk shifting by increasing their exposure to risky assets, so as to improve on the ROE, at least in the short run. Thus, the tax levy may motivate banks to engage in risk shifting by switching credit allocation more towards riskier loans, and this switching can be accomplished without increasing the overall volume of bank credit. The latter point is notable, given the constraint the tax may result on banks' overall credit growth (see H1).

Thus, our second hypothesis contends that banks would adjust the risk profile of loans by shifting lending more towards the higher risk, higher return segment of consumer loans and away from loans to the less risky corporate and mortgage sectors.

H2: The bank tax motivates banks to shift the risk profile of loans toward riskier sectors (consumer loans) and away from less risky sectors (mortgage and corporate loans).

5.3 Balance-sheet channel

Research on the bank lending channel suggests that individual banks differ in their ability to withstand regulatory or policy shocks, and certain bank-specific characteristics may amplify or dampen the effects of these shocks on lending (Van den Heuvel, 2006; Disyatat, 2011; Halvorsena and Jacobsenb, 2016). Referring specifically to banks' response to a new levy, the degree to which banks reduce lending may depend on the strength of their balance sheets. Amid negative shocks, markets tend to penalize more severely banks that are a priori less efficient and less capitalized – low-quality banks (*LQB*s). These banks, facing greater capital constrains, would be subject to stronger supervisory scrutiny, and would also be more vulnerable to suffering from a variety of "informational frictions" (Brei et al., 2019). To preserve capital and reduce financial vulnerability, low-quality banks therefore would take more forceful actions in response to the new tax.

Thus, our next hypothesis conjectures that following the tax levy, low-quality banks (*LQB*s) would be more likely to deleverage by cutting back on lending than would high-quality banks (*HQB*s). Being better positioned financially, the high-quality banks would be more capable of adapting to the new tax without having to retrench as much on lending.

H3: In response to the new tax, LQBs will reduce by more their lending than will HQBs.

6. Empirical strategy and data

6.1 Research design

In our empirical analysis, we investigate the adjustments of Polish banks on loan extensions and on costs of credit as a result of the bank levy. It is generally difficult to ascertain the impact of the new tax because any adjustments by banks may also depend on other factors, such as the

slope of the credit demand curve (Karlan and Zinman, 2005), the degree of competition (Allen et al., 2011), macroeconomic and financial conditions (Quagliariello, 2009), banks' business models (Biron et al., 2019) as well as their risk appetites and tolerance (Osborne et al., 2017). To account for the diverse factors and heterogeneity in banks' responses to the tax, we exploit a unique feature of disaggregated, bank-level data using panel data models.

6.1.1 Credit growth and lending margins

Our main empirical approach to examine the impact of the tax on banks' lending and credit spreads is a panel regression setup that controls for bank-level characteristics, banking sector specifics, and macro-financial conditions, using a panel fixed-effects estimator. The baseline model is:

$$Y_{i,t} = \alpha + \beta_1 Y_{i,t-1} + \beta_2 \mathrm{Tax}_{i,t} + \beta_3 X_{i,t-1} + \beta_4 Z_{t-1} + \mu_i + \varepsilon_{i,t}. \quad (1)$$

In Eq. (1), dependent variable $Y_{i,t}$ refers to either credit growth or credit margin applied by bank i at time t to the non-financial private sector. Credit growth (*CREDIT*) is measured as a quarterly percentage change in the stock of a loan portfolio, and credit margin (*SPREAD*) as the spread of lending rate on new business over the benchmark Warsaw interbank offering rate (*WIBOR*). The key variable of interest is the bank tax dummy (*TAX*), which equals 1 for banks that pay the tax in a quarter after its introduction in 2016Q1 and equals 0 for all other banks. Consequently, coefficient β_2 is of main interest to our analysis since it measures the short-term impact of the tax on credit growth or lending spreads, and the long-run effect is given by $\beta_2/(1-\beta_1)$. Hypothesis 1 predicts a negative (positive) effect of the tax on credit growth (credit spreads). Thus, if *H1* is correct, we expect the respective regressions to yield a negative coefficient on credit growth ($\beta_2 < 0$ on *CREDIT*), and a positive coefficient on credit spreads ($\beta_2 > 0$ on *SPREAD*).

To control for other conditions affecting bank credit and lending rates, we include a vector of bank-specific (X) and macro-financial variables (Z) in the regressions. The vectors of coefficients β_3 and β_4 indicate the effects of these control variables on banks' lending dynamics and margins. The idea behind the control is that bank-level characteristics as well as exogenous economic and banking-sector conditions affect lending by individual banks. We also include the lagged dependent variable as control for persistence because of possibly delayed adjustments by banks on credit growth and margins. Bank fixed effects (α_i) control for unobservable time-invariant bank-specific factors that may affect decisions on loans and margins, and the clustered standard error allows us to consider simultaneously the heteroskedastic and serial correlations of the error term.

Since the lagged dependent variable is correlated with the error term due to the presence of time invariant individual effects, our regressions could in principle generate inconsistent estimates (Nickell, 1981). However, because our estimation sample covers a relatively long time period of 47 quarters (2007Q2 through 2018Q4), we use an Arellano and Bond (1991) type of estimator to address the dynamic structure. To further buttress the credibility of our results, in the robustness section, we consider a system generalized method of moments (SYS-GMM) methodology to address endogeneity issues and show the robustness of our results (Blundell and Bond, 1998).

We recognize that endogeneity is a common concern on this type of analysis using banks' accounting ratios due to the issue of simultaneity (Wintoki et al., 2012). For instance, regressing credit volume on the capital adequacy ratio may be problematic because credit volume affects the risk-weighted assets in the first place. A similar problem exists for macroeconomic variables. For example, increased credit can simultaneously stimulate consumption and investments. We control for the potential endogeneity issues among the macroeconomic variables, bank balance sheet components, and the dependent variable by lagging the right-hand

side variables, which is a standard practice in the literature (see, e.g., Kashyap and Stein, 2000; Cornett et al., 2011).

One final note is that our analysis assumes that the new tax burden affects the dependent variables (credit growth or lending spreads) within the same quarter. The idea is that recognizing the impact of the tax on profits, banks would take immediate mitigating actions on lending margins and credit allocations to address the problem.

6.1.2 Portfolios' search for yield

In this part, we test whether banks change the structure of loan portfolios toward higher return, higher risk loans in response to the bank tax. Specifically, we estimate the following model:

$$Y_{i,k,t} = \alpha + \beta_1 Y_{i,k,t-1} + \beta_2 \text{Tax}_{i,t} + \beta_3 X_{i,t-1} + \beta_4 Z_{t-1} + \mu_i + \varepsilon_{i,t}. \quad (2)$$

In Eq. (2), dependent variable $Y_{i,k,t}$, refers to credit growth or credit margin for bank i for a given loan portfolio k at time t. The remaining variables are the same as in Eq. (1). We consider three types of loan portfolios, those of consumer, mortgage, and corporate loan type, for the following reasons. First, they are the most common types of bank credit and have the greatest data coverage across banks and over time. Second, the three loan types differ significantly in their levels of risk and profitability. Third, the steady flow of bank credit to corporations and households is critical to development in the real sector and to financial stability.

We argue in Hypothesis 2 that banks' responses to the new tax may be asymmetrical across different loan categories because of their varying risk-return tradeoffs. We conjecture that banks would shift lending towards sectors that would generate higher profits even with higher risk (consumer loans) and away from lower return and lower risk sectors (mortgage and corporate loans). If *H2* is true, we expect to observe a significantly negative (positive) impact of the tax on the growth of (lending rates on) mortgage and corporate loans, and an insignificant or possibly positive (negative) impact on the growth of (lending rates on) consumer loans.

6.1.3 Heterogeneity in banks' credit responses

We investigate here whether the effects of the bank tax vary between banks of different quality, i.e., between the high-quality *HQB* and the low-quality *LQB*. For this purpose, we add to the baseline model an interaction term between the tax dummy (*TAX*) which captures a bank paying the tax and another dummy that equals 1 for an *HQB* bank and 0 for an *LQB*. A bank is classified as *HQB* or *LQB* using two key characteristics that indicate the bank's overall profitability and its general level of risk (Disyatat, 2011; Jakab and Kumhof, 2015; Gunji and Yuan, 2010). The profitability measure used is the return on equity ratio (*ROE*) while the general risk (solvency) level is captured by the capital adequacy ratio (*CAR*). An *HQB* is a bank that lies in the upper tercile of the time-varying distribution of the regression sample.[3] Including the interaction term, $Tax_{i,t} \times HQB_{i,t-1}$, we now estimate the following model:

$$Y_{i,k,t} = \alpha + \beta_1 Y_{i,k,t-1} + \beta_2 Tax_{i,t} + \beta_3 Tax_{i,t} \times HQB_{i,t-1} + \beta_4 X_{i,t-1} + \beta_5 Z_{i-1} + \mu_i + \varepsilon_{i,t.} \qquad (3)$$

The above approach is more flexible than the earlier one because it allows banks' reactions on credit to be nonlinear. Coefficient β_3 here on the key interaction variable ($Tax_{i,t} \times HQB_{i,t-1}$) reflects the effect of the tax as related to the classification of the bank quality. In line with Eq. (2), we examine the effect of the tax levy on the volumes of banks' credit portfolios.

Hypothesis 3 predicts a positive interaction coefficient ($\beta_3 > 0$), indicating a less pronounced effect of the tax on high-quality banks, those having higher profitability and solvency ratios. The intuition is that the new tax is less likely to affect the asset side of well-performing (high-quality) banks since regulatory boundaries or constraints are unlikely to be binding for these banks. In comparison, poor-performing (low-quality) banks have less

[3] For example, Hainmueller, Mummolo, and Xu (2019) recommend this estimation strategy.

financial flexibility to cope with the tax burden and therefore may have to limit or adjust their credit expansions.

6.2 Control variables

We can interpret the explanatory variables in the regression analysis as more representative of either credit demand or credit supply. Although disentangling different factors into these two groups is not our research objective, we try to capture both, as omitting significant ones might result in biased estimates. We consider macro-financial variables as loan demand factors as they represent aggregate economic conditions that are critical to determining the need for external sources of funding. We control for the ability of banks to provide financing to the real economy with the bank-level variables which we believe reflect loan supply factors.

Several variables are employed to control for bank-specific characteristics. We use a bank's return on equity (*ROE*) to reflect its income-producing ability. A bank with a higher ROE is also likely to be better managed and more financially stable. Thus, banks with a higher ROE should record higher credit growth. As noted in Gambacorta and Mistrulli (2004), Berrospide and Edge (2010), and Jiménez et al. (2012) among others, bank capital is of critical importance to sustainable lending. Better capitalized banks should be more capable of withstanding external shocks and continuing lending, for instance, even in severe macroeconomic downturns. We measure bank capital using the average ratio of Tier I capital to total risk-weighted assets (*CORT1*). We expect that banks with a higher capital ratio should have the capacity to absorb losses and should therefore exhibit weaker credit contractions in an economic bust (Popov, 2016). Byrne and Kelly (2019) argue that banks' ability to supply credit and decrease loan pricing in response to reductions in the policy rate is hampered by the post-crisis overhang of bad loans in the Eurozone. We control for banks' distressed loan books using the non-performing loan ratio (*NPL*). We anticipate a negative correlation between *NPL* and credit growth, as a high level of NPL can distort credit allocations, increase market uncertainty, reduce

credit supply, and thereby act as a drag on economic growth (Balgova et al., 2016; Cucinelli, 2016). We measure bank liquidity using the liquid assets ratio (*LIQ*). We predict a positive correlation of *LIQ* with banks' loan growth. Greater liquidity allows a bank to more readily meet its current and future cash flow needs without running into unexpected funding difficulties. Likewise, we expect the deposit ratio (*DepShare*) to have a similar effect on loan growth since deposits are the more stable part of banks' sources of funds. Following Durpey (2015) and Naceur and Roulet (2018), we control for the effects of mergers and acquisitions by introducing a dummy variable that equals 1 if the quarterly credit growth exceeds 15 percent (60% YtY), and 0 if otherwise.

Concerning market power, we control for the relative size of individual banks and also for the overall degree of competition in the banking industry. We construct a variable (*Assets*) to control for bank size, which represents the share of the bank's assets relative to the banking sector's total assets. We capture the degree of competition in the banking industry with the Herfindahl–Hirschman index (*HHI*), a measure of the asset concentration in the industry. All else the same, we expect a positive relation between the *Assets* ratio and credit growth, as a greater size enables the bank to benefit more from the economies of scale. However, in a more competitive, less concentrated banking industry, any individual banks would have less space to expand their lending portfolios without facing strenuous competition.

We employ the GDP growth rate (*GDP*) and the Warsaw interbank rate (*WIBOR*) as macroeconomic control variables. The former reflects the strength of the overall economy and the latter helps capture the effect of business cycle on banks' credit and margins. Borio (2014) and Borio and Gambacorta (2017) document that economic growth, rising house and stock prices, improving labor markets, and low real interest rates are some of the forceful drivers of credit expansion. Thus, GDP growth would have a positive impact on loan dynamics while higher interest rates would curb credit growth.

Additionally, we include as control Kremer et al.'s (2012) Composite Indicator of Systemic Risks (*CISS*). The CISS indicator constitutes a single statistic measuring the current state of financial instability – the current level of frictions, stresses, and strains (or their absence) in the financial system. We anticipate that the CISS will be negatively associated with loan growth. During periods of mounting financial market tensions, banks tend to build up capital and liquidity buffers by limiting the supply of credit. Thus, banks will likely reduce their capacity to lend in times of severe market pressure (Borsuk and Kostrzewa, 2020).

6.3 Data

This study utilizes a unique set of granular supervisory data on 34 commercial banks in Poland that comprise the entire Polish banking system during the 2007Q2–2018Q4 period. In the last three years of this period, the new tax levy on bank assets is in effect for all these banks. We employ other sources of information concerning bank-specific and macro-level variables. The data on macroeconomic and financial conditions is collected from Bloomberg. A key source of bank-specific data is the banks' supervisory financial reports that include data on all balance sheet, profit and loss items as well as supervisory risk indicators. We supplement this dataset with the lending rate information from the monetary financial institutions (MFI) balance sheet statistics collected for monitoring monetary developments. An advantage of the latter dataset is its inclusion of statistics on the interest rate for new loans of different types. Although the supervisory and the statistical reporting data have much in common, the two datasets differ in coverage. The former includes all 34 banks operating in Poland since 2007 while the latter covers only a sample of 22 commercial banks that participate in the survey. Both datasets provide the information at a quarterly frequency. After merging the databases, we obtain an unbalanced panel for 34 commercial banks covering around 75–85% of the total aggregate balance sheets of banks in Poland.

We remove startups and outliers from the sample. Specifically, we exclude institutions that were not active for at least eight consecutive quarters. We also exclude banks having the total assets of less than 2 billion euros at the end of a quarter (Huang and Ritter, 2009) or having insignificant credit portfolios because the low base effect or portfolio sales could distort loan dynamics in the analyzed credit segments of corporate, consumer, and mortgage loans. We took 5% as the threshold value of the total loan portfolio of a given bank. Finally, we drop outliers by winsorizing the bank-specific indicators at the 5th and 95th percentiles.

In Panels B and C of Table 2, we report descriptive statistics for the variables used in our main regressions. The definitions of all variables and their sources are presented in Appendix A. All variables are tested for stationarity using panel unit root tests. The mean value of quarterly credit growth (*CREDIT*) and lending margin (*SPREAD*) to the non-financial sector are 2.1% and 4.5%, respectively, indicating moderate credit expansion and a relatively high cost of credit intermediation.[4] The mean values and distributions of the CAMELS-type variables[5] show that on average, the banks in our sample are relatively safe and sound.

Table 3 presents the Pearson correlation coefficients across the dependent variables and key independent variables. The main variable of interest, the bank tax dummy (*TAX*), is negatively correlated with the quarterly credit growth (*CREDIT)* and credit margin (*SPREAD*). However, there are some differences between individual portfolios. The tax levy is positively correlated with the growth rate of the consumer loan portfolio (*CREDIT_CONS*) and the lending spread on the mortgage portfolio (*SPREAD_HOUS*). For most indicators, the pairwise correlation coefficients range between -0.5 and 0.5 for our variables, indicating a weak-to-moderate degree of correlation and a minimal possibility of multicollinearity.

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[4] According to ECB aggregated data, Polish banks have one of the highest lending margins in Europe.

[5] Regulators worldwide often use the CAMELS rating to evaluate the safety and soundness of commercial banks. The acronym CAMELS stands for capital adequacy, asset quality, management, earnings, and sensitivity of market risk (Kupiec et al., 2017).

[Table 3 goes about here]

7. Results

7.1 Impact on credit spread

We present in Table 4 the results from the credit margin models for four sub-samples. The results show that banks react to the new tax by increasing the cost of credit to the real economy. In column (1), the coefficient of the tax dummy is positive and statistically significant at the 5% level, indicating that the tax levy is positively associated with the lending rates. The short-run effect of the bank tax on credit spreads in the non-financial sector is 24 basis points, and the long-run effect is 139 basis points. Thus, the new tax burden is economically meaningful, particularly since the average loan margin in our sample is 446 basis points.

[Table 4 goes about here]

Next, we investigate how the new tax affects credit margins among different loan types. In columns (2) through (4), the coefficients on the tax levy are not stable across the regression variants. Banks appear to pass on the cost of the tax to mortgage loans but keep the pricing of credit to other sectors largely unchanged after controlling for other factors. In column (2), the coefficient of the tax variable is positive and significant at the 1% level. The results are also economically significant since the estimate implies that the new tax increases the credit spread on the mortgage portfolio by around 15 basis points in the short run and by 44 basis points in the long run. In columns (3) and (4), the coefficients on the new tax are insignificant, suggesting that banks do not increase the lending rates on corporate or consumer loans in spite of the additional tax.

The above findings are consistent with the *risk channel hypothesis*, which argues that banks would tighten the terms of lower-risk, lower-yield loans (such as mortgages) by increasing their costs and decreasing their availability. However, there is an alternative explanation for our

results. DeFusco and Paciorek (2017) estimate the interest rate elasticity of mortgage demand using U.S. data and find generally small responses to changes in mortgage rates. The weak response suggests that it might be easier for banks to reprice mortgage loans (Fuster and Zafar, 2014; Borio and Hofmann, 2017; Blancard and Havrylchyk, 2017).

In terms of control variables, the capital adequacy ratio has a negative coefficient in all specifications and is significant in columns (1) and (3), indicating that better capitalized banks charge lower credit margins to clients. Other bank-specific variables are generally insignificant, meaning that these variables have minor explanatory power for credit pricing. The results suggest that lenders might be viewed as price takers in Poland's relatively competitive loan market.

In contrast, macro control variables play an important role in determining loan pricing. In columns (1) through (4), the real GDP growth, short-term market rate, and systemic risk index variables all display consistent signs across loan portfolios and are statistically significant. For example, the rate of real GDP growth is negatively associated with lending spreads. An increase in real GPD growth, indicating a better performing real economy, leads to a lower risk premium and hence a smaller credit spread. This result is in line with prior research (e.g., Kapuściński and Stanisławska, 2018). The estimated coefficient of the short-term rate has a negative sign, although significant only at the 10% level. This outcome might reflect the existence of a *re-pricing lag effect* (Brei et al., 2019) that banks tend not to reduce lending rates as much as the central bank when it lowers the benchmark rates. Our results also show that an increase in the CISS is associated with higher lending spreads. A partial explanation is that the periods of financial instability see an increase in risk premium, for which banks account through higher loan rate spreads. Finally, as expected, the coefficient on the lagged dependent variable is positive and statistically significant at the 1% level, indicating certain persistence on banks' credit margins.

7.2 Impact on lending and risk-taking

We now repeat the previous estimation but with the growth rates of banks' loan portfolios as the dependent variable. In column (1) of Table 5, we show that the tax levy is negatively and significantly associated with loan growth. The results are also economically significant. Ceteris paribus, the tax levy reduces the private sector loan growth by about 0.7 p.p. in the short run and by 0.9 p.p. in the long run. The results are consistent with Hypothesis 1 that the bank tax has significant adverse effects on credit growth both statistically and economically.

[Table 5 goes about here]

In columns (2) through (4), we show the disaggregated results for mortgage, consumer, and corporate loan portfolios. We find some signs of risk shifting by banks. On the mortgage loan specification, the coefficient of the tax dummy is negative and statically significant at the 1% level. On the consumer and corporate loan models, the same coefficient, although still negative, is statistically insignificant. The results suggest that responding to the new tax, banks significantly reduce mortgage lending but do not substantially alter credit supply to other loan segments. In other words, banks adjust the structure of their loan portfolios in reaction to the tax burden. The results are consistent with those of the earlier lending margin regressions, both supporting the view that the tax levy prompts a revision of banks' loan allocations.

We can think of two possible explanations for why there are no significant shifts in banks' consumer and corporate lending levels following the new taxation. On the consumer side, demand for bank credit may be limited in a highly competitive retail market, constraining banks' ability to boost the volume of consumer credit. On the corporate side, these clients tend to be highly sensitive to changes in the terms and conditions of loan contracts because they are more able to replace banks or substitute bank loans with other forms of financing. Corporate clients are also likely to be multiproduct customers of a bank, and thus, their change of the banking relationship may prove to be too costly for the bank.

Bank-specific control variables generate several notable results. The coefficient of the lagged dependent variable is positive and significant, indicating strong persistence. The capital ratio is positively and statistically significantly related to bank lending to non-financial clients. We find that a 1 p.p. increase in capital raises bank lending by 0.2 p.p. This result is consistent with Cohen and Scatinga (2016) and Kim and Sohn (2017), who document that banks with higher capital ratios strongly expand their lending activities. We also find that banks with a higher share of NPL decrease their credit supply by more than those with a lower share of NPL. This result is similar to Constâncio's (2017) showing a significantly negative role of bad debts on the granting of new credit. There is also evidence that more profitable banks are in a better position to extend credit. The coefficient of *ROE* is positive and statistically significant in all specifications. In contrast, we find no strong relations between banks' liquidity and their lending levels as the coefficients for the liquidity variables are insignificant in most specifications. Likewise, we find no relations between banks' size and their loan dynamics, consistent with those of Roulet (2018) and Dahir et al. (2019).

With respect to macroeconomic variables, the results are summarized here. The coefficient of GDP growth is positive and significant in all specifications. The coefficient of the interbank rate is positive and statistically significant for the credit growth to the non-financial sector, probably because economic expansions (downturns) are accompanied by increasing (decreasing) central bank benchmark rates. We also observe a negative relationship between credit growth and CISS, in line with the idea that mounting financial market tensions with an accompanying drop in risk appetite lowers the demand for as well as the supply of credit to the economy.

7.2 Heterogeneity in bank responses

We next evaluate the effect of the bank levy on the growth of different categories of credit. We allow for non-linearities in banks' responses to the new tax. Of particular interest are the

interaction term variables, $Tax \times ROE_{HQB}$ and $Tax \times CAR_{HQB}$, which enable us to examine potentially heterogeneous responses to the levy by banks with different financial strength. We predict that the transmission of the tax to lending should be weaker for *HQBs* – banks with capital adequacy and return on equity ratios at the upper range of the sector's distribution.

The results in Table 6 show that the interaction term coefficient is statistically significant in two specifications. The interaction term in column (1) indicates that the effect of the levy on credit to the private sector differs between high- and low-quality banks. The coefficient estimate associated with the interaction term of *TAX* and ROE_{HQB} is positive and statistically significant at the 1% level. Thus, following the new tax, the rate of growth in lending to the private sector decreases less for highly profitable banks than for less profitable banks. The coefficient of the interaction term in column (2) is also positive and statistically significant at the 5% level, suggesting that the effect is mainly driven by mortgage loans. In columns (3) and (4), the interaction term is insignificantly related to loan growth. An explanation for the results is that the tax-adjusted margin on low interest-bearing mortgages probably no longer covers their associated costs, making mortgage loans unattractive for low-quality banks. However, high-quality banks, which on average have lower costs (funding, operating, and credit), are able to decrease by less the growth of mortgage loans since these banks may still find mortgage products sufficiently attractive.

[Table 6 goes about here]

In column (5), we find that the coefficient of the interaction of the tax levy and the capital adequacy ratio of *HQBs* ($Tax \times CAR_{HQB}$) is statistically insignificant, suggesting that while both variables independently have significant effects on lending to the real sector, high capital holdings do not dampen the negative effect of the new tax. However, on a more granular level, the relationship between mortgage loans and the tax differs between low-capitalized and high-capitalized banks. The estimated coefficient in column (6) of the interaction of the levy with

the capital adequacy ratio is positive and statistically significant at the 5% level, while the interaction coefficients of other loan portfolios remain statistically insignificant. The results indicate that the tax causes banks with a weak capital position to cut more on mortgage lending. One explanation is that capital-poor banks may be subject to tighter regulatory scrutiny and thus may have to cut back liquidity and capital intensive housing loans. It is also possible that poorly capitalized banks may be trying to improve the situation by allocating the capital to more profitable and possibly riskier products at the cost of low interest-bearing mortgages.

Considering that profitability and capitalization are positively correlated with lending, banks characterized by low efficiency and low capitalization may struggle to maintain a competitive position in the credit market. The tax burden, apart from limiting the capacity to accumulate capital internally, further impairs these banks' ability to lend, raising doubts on whether such banks have sustainable business models in the longer run.

In sum, we find that the introduction of the tax levy is associated with changes in both the pricing and supply of credit. This result holds after controlling for observable characteristics of banks as well as business cycle variations. With the new tax in place, banks increase loan spreads and reduce the supply of loans, particularly in the less risky, less profitable residential mortgage segment. Through this channel, banks appear to pass on the tax burden to the real economy.

8. Robustness check

To check the robustness of our main results, we conduct a wide array of additional analyses. First, we employ an alternative measure of the tax levy, *TAX_RATIO*, which is the amount of tax a bank pays in a given quarter divided by its total assets. This approach offers potential advantages by enabling us to exploit variations in each bank's exposure to the tax. Furthermore, by enabling direct estimates of the economically meaningful parameters, such as the sensitivity of credit growth and lending margins to the average tax levy, the tax ratio measure enhances

comparability with related studies of taxation and bank risk. We present the results for the sample of banks that have paid the tax regularly since its introduction. This choice allows us to better understand how the differences in the tax paid affect banks' decisions on lending and on risk shifting, particularly since the effective tax rate varies among banks due to the exemption of governments bonds and equity capital from the tax base.

In Table 7, we report results on lending rate spreads in columns (1) through (4), and those on credit growth in columns (5) through (8). The results are in line with the baseline estimations presented in Tables 4 and 5. The coefficient of the tax variable is positively related to the credit spreads on the non-financial sector loans and on mortgage loans, both statistically significant at the 5% level. The results in columns (5) and (6) confirm a significant negative effect of the tax ratio on credit to the non-financial sector, driven mainly by the decline in mortgage lending. Interestingly, we find that the coefficient of the tax ratio in the consumer loan model is now positive and significant at the 1% level. This result further supports our basic contention that in response to the tax, banks not only limit the supply of loans in low-profit segments (e.g., by increasing lending rates or tightening the standards and other terms on mortgage loans), but may also increase their exposure to more profitable, riskier segments (e.g., consumer loans). In particular, our results indicate that banks that are subject to a higher effective tax rate are taking more risk on their books to recover some of the forgone profits. From the policy perspective, the results suggest that an adequate calibration of the tax policy is important. There may exist an "optimal" tax rate which enables the government to raise certain revenues while minimizing the materially damaging effects on banks' critical function of providing credit to the real economy.

[Table 7 goes about here]

Next in our robustness test is to apply alternative specifications and estimation methods. We employ the annual credit growth rate instead of the quarterly changes [6] as the dependent variable. Using the annual data irons out potentially seasonal fluctuations in credit that might appear in the quarterly data (Murfin, 2016). Reported in column (1) of Table 8, the results confirm our earlier finding of a significantly negative impact of the bank tax on credit growth and show that any seasonality effects do not matter to the findings. The coefficient estimates of *TAX* on the annual date are negative and statistically significant at the 1% level, and the introduction of the tax results in a 2.8 p.p. drop in banks' annual credit growth.

[Table 8 goes about here]

We replicate our main regression analysis by incorporating additional control variables. Drehmann et al. (2012) and Krainer (2014) document that house prices and stock prices are important determinants for loan demand and loan supply. Column (2) of Table 8 reports the results of estimations that include as new variables, the index of residential housing prices (*HOUSE*) and stock market index (*INDEX*). The coefficient estimates of *HOUSE* and *STOCK* are both positive, although only the latter is statistically significant (at the 1% level). More importantly, our main variable of interest, *TAX*, continues to have a negative and significant association with credit growth.

A crucial identifying assumption underlying our analysis is that the coefficient of the tax variable captures the main effects of the new tax burden on bank credit. This assumption might not hold in general when the tax simultaneously affects other control variables. The concern applies particularly to the profitability measure (*ROE*) which according to our estimates, drops by around 2 p.p. as a result of the new tax. To investigate this issue, we perform a regression that includes the ROE in gross terms (*ROE_GROSS*). The results, reported in column (3) of

[6] We re-calculate loan growth using the difference between gross loans in quarter *t* and *t*-4 divided by loans in *t*-4. We also lag all the RHS variables by 4 quarters.

Table 8, show that *ROE_GROSS* is positively associated with *CREDIT* but is no longer statistically significant. While this result confirms to some extent the concern above, it does not change the negative and significant relationship between the tax levy and credit growth. In column (3), the coefficient of the *TAX* variable is still negative and statistically significant at the 1% level.

In column (4), we investigate the sensitivity of the results to several data filters, namely merger dummies, winsorization, as well as floors and caps on loan dynamics. The reported results show that the additional data filters do not influence our findings. The coefficient of the variables TAX remains negatively and is statistically significantly related to bank lending.

Additionally, we consider an alternative panel data estimator to account for the potential problems of bias with the fixed effect estimator and endogeneity concerns stemming from simultaneity.[7] We re-estimate our baseline models using the system GMM (SYS-GMM) dynamic panel estimator (Blundell and Bond, 1998). We instrument the regressors with two lags of their levels and first differences, respectively. Restricting the instruments two to three lags is important because the number of instruments for this estimator increases quadratically in *T*, and can thus become very large, overfitting the endogenous variables (Roodman, 2009). We also correct the standard errors by following Windmeijer's (2005) proposed procedure. We perform model specification validity tests. We first estimate the p-values of the Hansen test of over-identification of restrictions, which confirms the choice of instrumental variables. We find that the AR (1) and AR (2) statistics, which measure respectively the first- and second-degree serial correlations, display no serial correlation, confirming the validity of the GMM regression results. In columns (5) and (6), we present the results for credit growth and lending spreads

[7] Although we have a relatively long time series and use lagged control variables to mitigate endogeneity concerns in our baseline models, Judson and Owen (1999) and Phillips and Sul (2007) argue that even for *T* as large as 30, this bias may be sizeable, in excess of 20%.

estimated using SYS-GMM. These results are comparable to those of our baseline models presented in Tables 4 and 5. In both specifications, the coefficient of the tax dummy has the correct sign and remains statistically significant.

Although the empirical evidence thus far suggests a negative impact of the ax levy on bank lending, the magnitude of this impact may depend on bank-specific characteristics. We investigate this issue further by adding to the model the interaction terms of the tax dummy with all bank-level control variables. This approach is more flexible than those employed previously as it is not based on the arbitrary choice of the level of a moderator (conditioning variable). Moreover, it extends the analysis of non-linearities by examining a broader set of variables besides *CAR* and *ROE*.

For brevity, we present in Table 9 only the estimation results for the growth of the non-financial sector loans (the results for all other models are available upon request). We find that only the interaction term of *TAX* x *ROE* is positive and statistically significant (at the 5% level). This result is broadly in line with our previous findings, again indicating that the negative effect of the levy on credit growth diminishes as the ROE increases. The coefficients of other interaction terms are statistically insignificant, indicating that other bank characteristics play little role in the transmission of the tax shock to credit growth. Thus, our study reinforces a key role played by profitability (ROE) in banks' ability to mitigate the effects of adverse policy changes on their credit provision to the real economy.

[Table 9 goes about here]

Overall, the results of our robustness tests using alternative measures of the tax levy, additional control variables, and a different methodology all confirm the baseline findings of a negative effect of the tax on credit growth. The magnitude of this effect is stable across all baseline and alternative models, highlighting the robustness of the main results.

9. Conclusions

The introduction of bank levies in many European countries following the global financial crisis of 2007-2008 prompts a serious debate about the implications of this fiscal tool. Important global institutions such as the ECB and IMF have warned that imposing ad hoc tax surcharges on banks may be counterproductive by creating uncertainty for their business and posing additional risks to their provision of credit to the real economy. Using the experience of Polish introduction of a tax levied on bank assets, we empirically examine the impact of this tax on banks' credit provision and its implications for financial stability.

Our results show the significant negative effects of the tax on banks' supply of loans. We find that banks pass on the tax burden by increasing lending rate spreads on new loans to the non-financial private sector. Banks also alters the structure of their credit portfolios by shifting lending more towards types of loans that offer a higher return, albeit with a higher level of risk. Furthermore, our analysis highlights cross-sectional heterogeneity in banks' behavior in response to the tax. Compared with high-profit banks, banks with low profits, which have limited financial flexibility, show a more pronounced decrease in their overall lending, following the levy. Our results are consistent with the argument that the tax levy motivates banks to divert productive resources to find ways to circumvent the tax. Some of the ways they choose to pursue are damaging to the real economy and have serious implications for financial stability.

The Polish experience offers lessons for economic policy. First, they serve as lesson-learned for other countries contemplating the introduction of a similar levy to raise revenues. The concern for additional sources of revenue is particularly acute at this point in time because many countries worldwide are experiencing a dramatic increase in budget deficits due to the Covid-19 pandemic. Second, understanding the impact of a bank levy on credit supply is important in the context of macroprudential policy. For example, taxing loans is thought to be an alternative

to the countercyclical capital buffer to tame excessive credit growth. However, our analysis suggests that unlike capital requirements, a fixed percentage tax rate on bank assets (e.g., loans) can make the banking sector less resilient and can be dangerous to the real economy.

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Table 1. Bank taxes implemented in European countries between 2009 and 2019.

Country	Date of implementation	Tax Base	Tax rate	Exemptions
Austria	2011	Total liabilities	< EUR 20bn: 0.024% >EUR 20bn: 0.029%	Equity and insured deposits
Belgium	2012	Total liabilities	0.035%	Insured deposit
Cyprus	2011	Total amount of deposits	0.15%	Interbank deposits, deposits from foreign financial institutions
Finland	2013	Risk-weighted assets	0.125%	NA
France	2011	Minimum regulatory capital as determined based on risk-weighted assets	0.25%	€500 millions of minimal own funds requirement
Germany	2011	Total liabilities and off-balance sheet derivatives	0.02% - 0.06% 0.0003% for off balance sheet derivatives.	Customer deposit and equity capital
Hungary	2010	Total assets	< HUF 50bn: 0.15% >HUF 50bn: 0.20%	Interbank loans
Iceland	2011	Total liabilities	0.376%	Liabilities below ISK 50 billion
Latvia	2011	Total liabilities	0.036%	Equity and insured deposits
Netherlands	2012	Total liabilities	0.0% - 0.044%	Equity and insured deposits
Poland	2016	Total assets	0.44%	Assets bellow PLN 4 bn and sovereign debt
Portugal	2011	Total liabilities	0.05%	Equity and subordinated debt
Romania	2018	Total assets	<1% market share: 0.20% and >1% market share: 0.40% with tax waivers	Cash, cash balance at central banks, sovereign debt, interbank market, NPLs
Slovakia	2012	Total liabilities	0.4%	Equity and insured deposits
Slovenia	2011	Total assets	0.1%	The levy is not due if the growth in lending exceeds a threshold
Sweden	2009	Total liabilities	0.036%	Equity and insured deposits

United Kingdom	2011	Total liabilities	0.016% short term liabilities 0.08% long term liabilities	Equity and insured deposits with certain adjustments

Note: In Finland the bank tax was collected in tax years 2013–2015. Source: European Union (source: Taxes in Europe Database).

Table 2. Selected financial soundness indicators of the banking sector in Poland

The average effective tax rate includes the CIT and bank levy. The effective interest on credit (liabilities) is the ratio of annualized interest income (expense) to the annual average balance-sheet value of credit (liabilities). Growth rates of credit and deposits refer to the non-financial sector.

in %	2013 Q4	2014 Q4	2015 Q4	2016 Q1	2016 Q4	2017 Q4	2018 Q4
Panel A. Bank levy facts							
Number of taxed banks	0	0	0	18	18	21	23
Share of taxed banks in the sector assets	0	0	0	91.01	88.73	89.50	90.09
Average effective tax rate	18.77	19.50	18.59	31.39	36.73	38.60	41.92
Panel B. Banking sector characteristics							
Share of non-financial loans in total assets	60.22	59.06	60.71	60.24	59.91	59.64	58.91
Share of sovereign securities in total assets	10.47	12.40	12.75	15.46	16.08	16.22	16.45
Share of state-owned banks in the sector assets	22.30	24.10	23.90	28.25	28.85	40.01	39.61
Annual assets growth rate	3.29	9.05	4.55	4.18	6.44	3.43	5.19
Annual credit growth rate	2.21	6.95	7.75	5.56	5.04	1.61	4.36
Annual deposit growth rate	6.53	9.22	10.00	9.68	8.43	4.63	8.29
Effective interest on credit	5.61	5.22	4.42	4.34	4.26	4.42	4.39
Effective interest on liabilities	2.29	1.71	1.29	1.21	1.10	1.02	0.96
NIM	2.45	2.46	2.21	2.23	2.28	2.45	2.54
C/I	52.08	49.25	57.54	59.02	54.96	54.47	54.69
ROA	1.12	1.11	0.84	0.76	0.86	0.81	0.85
ROE	11.79	12.22	9.50	8.60	8.42	8.41	8.83
CAR	15.80	14.61	15.98	16.60	17.19	18.07	18.44
P/BV	1.83	1.61	1.11	1.16	1.11	1.31	1.07
Panel C. Macroeconomics variables							
GDP	2.7	3.3	4.6	3.1	2.8	5.1	4.9
Unemployment rate	13.4	11.4	9.8	10.3	8.3	6.6	5.8
Central bank interest rate	2.5	2.0	1.5	1.5	1.5	1.5	1.5

Figure 1. Annual growth rates (left panel) and lending spreads (right panel) across different credit categories of domestic commercial banks.

Lending spreads are calculated as the difference between the average interest rates on new credit and the average interbank rates.

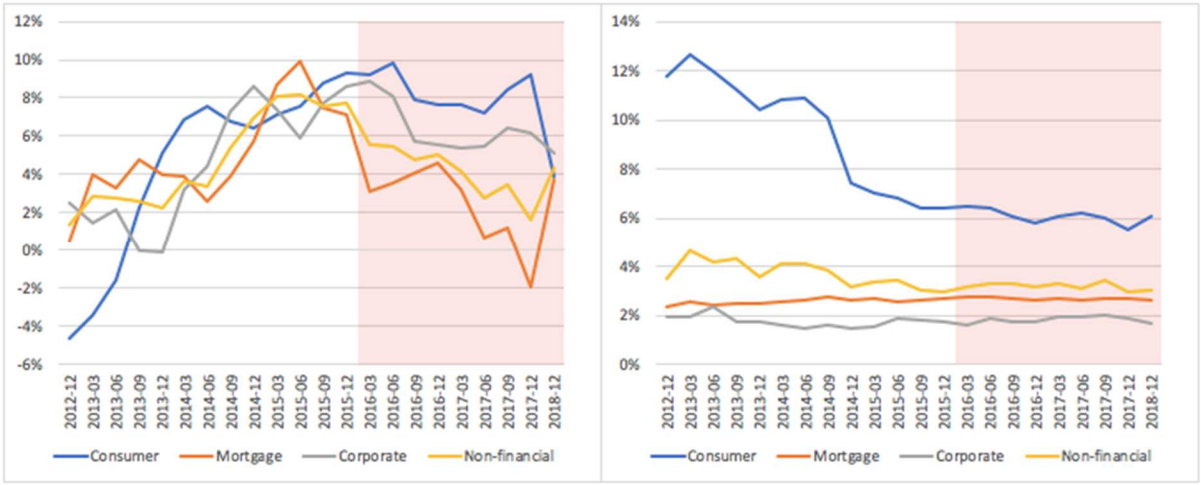

Figure 2. Credit standards for different credit categories from a senior loan officer opinion survey (left panel) and the average effective bank tax rates of banks in the sample (right panel).

Credit standards are the minimum standards of creditworthiness set by banks that the borrower must meet to obtain a loan (for more, see NBP, 2019). The difference between the number of banks in Table 2 and Figure 2 (left panel) stems from the fact that we exclude mortgage banks and branches of credit institutions from our sample. Annualized data.

Table 3. Summary statistics of the main variables

This table reports the summary statistics of the main variables used in the empirical analysis. All bank level variables based on accounting data are winsorized at the 5th and 95th percentiles.

	N	Mean	Min	Max	Std. Dev.	p25	Median	p75
CREDIT	1161	2.09	-7.56	13.96	3.93	-0.56	1.5	4.42
CREDIT HOUSE	821	2.23	-5.46	14.38	4	-0.62	1.6	4.66
CREDIT CONS	863	1.64	-13.69	14.09	4.29	-1.1	1.45	4.11
CREDIT CORP	983	1.89	-11.57	14.26	4.59	-1.32	1.64	5.34
SPREAD	645	4.46	1.24	16.2	2.5	2.86	3.89	5.35
CREDIT HOUS	597	2.48	0.56	7.34	0.84	2.01	2.5	2.86
CREDIT CONS	645	8.61	2.68	17.64	3.41	6.07	7.85	11.38
CREDIT CORP	632	2.05	-1.86	5.36	0.88	1.4	2.01	2.57
TAX	1361	0.13	0	1	0.34	0	0	0
TAX RATIO	1361	0	0	.03	0.01	0	0	0
ASSETS	1361	3.45	0.02	20.95	4.61	0.34	1.48	4.92
ROE	1209	8.5	-26.82	34.6	7.58	3.12	8.43	13.25
LIQUIDITY	1311	18.06	0.06	61.67	12.51	9.73	16.12	24.73
DEPOSITS	1354	46.63	0.21	83.71	24.6	34.37	52.53	66.82
CAR	1361	14.62	6	40.87	6.67	10.37	12.65	16.73
NPL	1338	8.93	0.39	30.67	5.35	5.15	7.97	11.15
GDP	1361	0.89	-0.15	1.7	0.52	0.49	0.95	1.31
WIBOR	1361	3.56	1.67	6.52	1.53	1.73	3.82	4.74
HHI	1361	0.06	0.05	0.07	0	0.06	0.06	0.07
CISS	1361	5.77	1.38	16.95	3.27	3.48	5.23	7.3

Table 3. Matrix of pair-wise correlations between variables.

This table reports pair-wise Pearson correlations between variables

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
(1) CREDIT	1																			
(2) CREDIT_HOUS	0.642	1																		
(3) CREDIT_CONS	0.532	0.234	1																	
(4) CREDIT_CORP	0.754	0.267	0.169	1																
(5) SPREAD	-0.089	-0.024	-0.095	-0.230	1															
(6) SPREAD_HOUS	-0.337	-0.317	-0.216	-0.205	0.124	1														
(7) SPREAD_CONS	-0.069	0.071	-0.180	-0.156	0.513	0.049	1													
(8) SPREAD_CORP	-0.094	-0.042	-0.066	-0.189	0.283	0.246	0.193	1												
(9) TAX	-0.118	-0.219	0.029	-0.015	-0.211	0.265	-0.457	-0.082	1											
(10) TAX_RATIO	-0.102	-0.198	0.056	-0.014	-0.203	0.257	-0.433	-0.056	0.958	1										
(11) ASSETS	-0.007	0.046	0.052	-0.017	-0.172	-0.023	0.178	-0.097	0.216	0.282	1									
(12) ROE	0.139	0.238	0.167	0.138	0.150	-0.318	0.335	-0.273	-0.021	-0.005	0.383	1								
(13) LIQUIDITY	-0.061	0.013	0.067	-0.024	-0.394	0.188	-0.013	-0.101	0.081	0.049	0.056	-0.053	1							
(14) DEPOSITS	-0.013	-0.075	0.093	-0.061	-0.364	-0.068	-0.076	-0.013	0.281	0.270	0.381	0.087	-0.010	1						
(15) CAR	-0.118	-0.202	-0.091	-0.042	-0.146	0.112	-0.057	-0.205	0.049	0.056	-0.149	-0.101	-0.147	-0.164	1					
(16) NPL	-0.237	-0.156	-0.332	-0.167	0.467	0.065	0.090	0.202	-0.132	-0.144	-0.219	-0.256	0.168	-0.100	-0.084	1				
(17) GDP	0.271	0.148	0.163	0.209	-0.093	-0.283	-0.274	-0.182	0.121	0.127	-0.004	-0.039	-0.074	-0.009	0.003	-0.021	1			
(18) WIBOR	0.309	0.353	0.035	0.217	0.252	-0.435	0.375	-0.157	-0.472	-0.452	-0.077	0.275	-0.223	-0.209	-0.247	-0.060	0.036	1		
(19) HHI	-0.163	-0.245	0.077	-0.086	-0.329	0.244	-0.518	0.027	0.496	0.474	0.076	-0.201	0.147	0.208	0.243	0.019	0.131	-0.823	1	
(20) CISS	0.244	0.300	0.095	0.167	0.194	-0.198	0.191	-0.105	-0.270	-0.259	-0.046	0.183	-0.166	-0.143	-0.171	-0.066	-0.057	0.574	-0.521	1

Table 4. The impact of the bank tax on lending spreads.

This table shows regression results estimated with a panel fixed effects model using data for 2007Q2–2018Q4. The dependent variables (DEP_VAR) represent the lending spreads of four types of loan portfolios: (1) non-financial loans, (2) mortgage loans, (3) consumer loans, and (4) and corporate loans. TAX is a dummy variable equal to 1 if a bank pays the tax in particular quarter, and 0 otherwise. All regressions include bank fixed effects, an M&A dummy, and a constant, but are not reported here for brevity. Appendix A provides the detailed definitions of the variables. Robust standard errors are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1) Non-financial	(2) Mortgage	(3) Consumer	(4) Corporates
DEP_VAR_{t-1}	0.829***	0.717***	0.861***	0.669***
	(0.027)	(0.074)	(0.022)	(0.015)
TAX	0.238**	0.145***	0.267	-0.112
	(0.1)	(0.045)	(0.174)	(0.065)
ASSETS	-0.01	0.003	-0.048	0.028*
	(0.035)	(0.022)	(0.039)	(0.016)
ROE	0.008	-0.009*	0.031*	-0.005
	(0.009)	(0.005)	(0.017)	(0.007)
LIQUIDITY	-0.007	0.004	0.018	0.000
	(0.007)	(0.003)	(0.011)	(0.003)
DEPOSITS	0.003	-0.004	0.012*	0.007
	(0.005)	(0.003)	(0.007)	(0.007)
CAR	-0.025**	-0.002	-0.031*	-0.003
	(0.011)	(0.006)	(0.017)	(0.01)
NPL	0.002	-0.025**	-0.002	-0.032
	(0.016)	(0.011)	(0.025)	(0.02)
GDP	-0.064***	-0.057***	-0.087***	-0.049***
	(0.019)	(0.009)	(0.028)	(0.015)
WIBOR	-0.129*	-0.085*	-0.165*	-0.046
	(0.064)	(0.041)	(0.092)	(0.031)
HHI	-45.449**	-13.732	-131.164***	-19.504
	(20.506)	(12.101)	(36.998)	(11.619)
CISS	0.066***	0.04***	0.022	0.008
	(0.018)	(0.011)	(0.023)	(0.01)
Bank fixed effects	Yes	Yes	Yes	Yes
Obs.	569	526	569	556
No. banks	20	18	20	19

Table 5. The impact of the bank tax on credit growth.

This table shows regression results estimated with a panel fixed effects model using data for 2007Q2–2018Q4. The dependent variables (DEP_VAR) represent the growth rates of four types of loan portfolios: (1) non-financial loans, (2) mortgage loans, (3) consumer loans, and (4) and corporate loans. TAX is a dummy variable equal to 1 if a bank pays the tax in particular quarter, and 0 otherwise. All regressions include bank fixed effects, an M&A dummy, and a constant, but are not reported here for brevity. Appendix A provides the detailed definitions of the variables. Robust standard errors are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1) Non-financial	(2) Mortgage	(3) Consumer	(4) Corporates
DEP_VAR_{t-1}	0.237***	0.19***	0.595***	0.172***
	(0.047)	(0.066)	(0.037)	(0.04)
TAX	-0.708**	-1.241***	-0.148	-0.34
	(0.314)	(0.409)	(0.467)	(0.591)
ASSETS	-0.201	-0.243	-0.179**	-0.325
	(0.271)	(0.151)	(0.078)	(0.408)
ROE	0.064***	0.071*	0.066**	0.095**
	(0.023)	(0.035)	(0.03)	(0.046)
LIQUIDITY	0.034	-0.089***	0.041**	0.068**
	(0.021)	(0.023)	(0.017)	(0.025)
DEPOSITS	0.004	-0.032	-0.013	-0.001
	(0.026)	(0.037)	(0.015)	(0.051)
CAR	0.199***	0.132	0.052	0.358***
	(0.05)	(0.085)	(0.05)	(0.096)
NPL	-0.242***	0.089	-0.073	-0.197*
	(0.043)	(0.078)	(0.045)	(0.1)
GDP	1.443***	1.995***	0.105	1.049***
	(0.273)	(0.409)	(0.23)	(0.349)
WIBOR	0.651***	0.721**	0.043	1.111***
	(0.226)	(0.255)	(0.209)	(0.288)
HHI	-65.573	-6.327	80.858	120.137
	(82.01)	(53.484)	(60.29)	(106.294)
CISS	-0.165***	-0.287***	-0.023	-0.129***
	(0.038)	(0.041)	(0.045)	(0.046)
Bank fixed effects	Yes	Yes	Yes	Yes
Obs.	943	686	718	775
No. banks	32	22	25	27

Table 6. Heterogeneity in bank response.

This table reports the estimates of the fixed effects model using data for 2007Q2–2018Q4. The dependent variables (DEP_VAR) represent the growth rates of four types of loan portfolios in the columns: (1 and 5) non-financial loans, (2 and 6) mortgage loans, (3 and 7) consumer loans, and (4 and 8) corporate loans. TAX is a dummy variable equal to 1 if a bank pays the tax in a particular quarter, and 0 otherwise. Banks' performance is measured with the ROE ratio (ROE) and capital adequacy ratio (CAR). HQBs are institutions that lie in the upper tercile of the time-varying distribution of ROE and CAR in the regression sample. All regressions include bank fixed effects, M&A dummy and constant but are not shown for brevity. Detailed definitions of variables are given in Appendix A. Robust standard errors are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
			HQB_{ROE}				HQB_{CAR}	
	Non-financial	Mortgage	Consumer	Corporates	Non-financial	Mortgage	Consumer	Corporates
DEP_VAR_{t-1}	0.233***	0.172**	0.594***	0.171***	0.235***	0.175**	0.594***	0.171***
	(0.045)	(0.067)	(0.037)	(0.04)	(0.046)	(0.066)	(0.038)	(0.041)
TAX	-1.106***	-1.94***	-0.333	-0.02	-1.022***	-1.849***	-0.235	0.181
	(0.334)	(0.48)	(0.578)	(0.715)	(0.325)	(0.509)	(0.582)	(0.807)
ASSETS	-0.178	-0.216	-0.168*	-0.341	-0.17	-0.178	-0.17*	-0.377
	(0.241)	(0.147)	(0.083)	(0.426)	(0.256)	(0.131)	(0.09)	(0.44)
ROE	0.061**	0.062*	0.064**	0.095**	0.064***	0.071*	0.066**	0.091*
	(0.023)	(0.034)	(0.03)	(0.046)	(0.022)	(0.035)	(0.03)	(0.046)
LIQUIDITY	0.038*	-0.077***	0.044**	0.066**	0.035*	-0.084***	0.042**	0.067**
	(0.02)	(0.025)	(0.019)	(0.025)	(0.02)	(0.021)	(0.018)	(0.025)
DEPOSITS	0.002	-0.038	-0.015	0.001	0.003	-0.035	-0.014	0.001
	(0.025)	(0.035)	(0.014)	(0.052)	(0.026)	(0.034)	(0.014)	(0.052)
CAR	0.195***	0.123	0.051	0.357***	0.184***	0.08	0.047	0.381***
	(0.05)	(0.076)	(0.049)	(0.095)	(0.052)	(0.088)	(0.051)	(0.095)
NPL	-0.245***	0.081	-0.075	-0.2*	-0.242***	0.091	-0.074	-0.204*
	(0.042)	(0.077)	(0.046)	(0.1)	(0.043)	(0.077)	(0.045)	(0.1)
GDP	1.44***	1.994***	0.1	1.054***	1.435***	1.98***	0.101	1.061***
	(0.276)	(0.413)	(0.23)	(0.349)	(0.273)	(0.405)	(0.228)	(0.35)
WIBOR	0.664***	0.74***	0.052	1.107***	0.651***	0.705**	0.043	1.124***
	(0.229)	(0.256)	(0.211)	(0.288)	(0.225)	(0.252)	(0.209)	(0.294)
HHI	-62.318	-0.849	83.95	119.66	-63.435	-3.014	82.291	119.59

	(82.934)	(53.292)	(60.702)	(106.22)	(82.16)	(53.525)	(60.547)	(106.595)
CISS	-0.164***	-0.278***	-0.022	-0.13***	-0.166***	-0.288***	-0.023	-0.127**
	(0.038)	(0.039)	(0.045)	(0.047)	(0.038)	(0.041)	(0.045)	(0.046)
$TAX \times HQB_{ROE}$	.876***	1.436**	0.381	-0.624				
	(0.317)	(0.533)	(0.465)	(0.683)				
$TAX \times HQB_{CAR}$					0.648	1.312**	0.174	-0.949
					(0.388)	(0.479)	(0.502)	(0.731)
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	943	686	718	775	943	686	718	775
No. of banks	32	22	25	27	32	22	25	27

Table 7. The impact of the tax ratio on credit growth and lending spread.

This table reports the estimates of the fixed effects model using data for 2007Q2–2018Q4. The dependent variables (*DEP_VAR*) represent the lending spreads and growth rates of four types of loan portfolios in the columns: (1 and 5) non-financial loans, (2 and 6) mortgage loans, (3 and 7) consumer loans, and (4 and 8) corporate loans. TAX_RATIO is the amount of levy paid by bank in given quarter by its total assets. All regressions include bank fixed effects, an M&A dummy, and a constant, but are not reported here for brevity. Appendix A provides the detailed definitions of the variables. Robust standard errors are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Spread				Credit			
	Non-financial	Mortgage	Consumer	Corporates	Non-financial	Mortgage	Consumer	Corporates
DEP_VAR_{t-1}	0.841***	0.773***	0.865***	0.634***	0.268***	0.165**	0.533***	0.103**
	(0.026)	(0.06)	(0.025)	0.865***	(0.082)	(0.064)	(0.035)	(0.047)
TAX_RATIO	11.954**	3.849**	14.468	-0.721	-26.23*	-41.432**	38.495***	-26.129
	(4.255)	(1.509)	(8.319)	(3.677)	(13.357)	(18.41)	(11.502)	(26.52)
ASSETS	-0.009	-0.001	-0.042	0.028	-0.243	-0.248	-0.249***	-0.609*
	(0.037)	(0.02)	(0.036)	(0.02)	(0.279)	(0.202)	(0.072)	(0.315)
ROE	0.005	-0.008	0.023	-0.002	0.05	0.099**	0.109***	-0.004
	(0.013)	(0.005)	(0.024)	(0.008)	(0.034)	(0.038)	(0.025)	(0.046)
LIQUIDITY	-0.007	0.005	0.016	-0.006	0.026	-0.073***	0.041*	0.028
	(0.006)	(0.003)	(0.012)	(0.004)	(0.03)	(0.022)	(0.023)	(0.025)
DEPOSITS	-0.001	0	0.01	-0.006	-0.01	-0.032	-0.037**	-0.054
	(0.005)	(0.002)	(0.012)	(0.012)	(0.03)	(0.035)	(0.014)	(0.049)
CAR	-0.007	-0.003	-0.015	0.009	0.152*	0.123	0.005	0.337***
	(0.007)	(0.005)	(0.016)	(0.008)	(0.077)	(0.101)	(0.041)	(0.094)
NPL	-0.015	-0.018	-0.018	-0.058*	-0.184**	0.153**	-0.05	-0.052
	(0.019)	(0.01)	(0.024)	(0.028)	(0.065)	(0.053)	(0.051)	(0.06)
GDP	-0.071***	-0.049***	-0.098***	-0.055**	1.695***	2.307***	-0.001	1.623***
	(0.022)	(0.01)	(0.03)	(0.021)	(0.248)	(0.386)	(0.226)	(0.254)
WIBOR	-0.066	-0.047	-0.088	-0.067	1.157***	0.96***	-0.181	1.876***
	(0.044)	(0.028)	(0.079)	(0.045)	(0.223)	(0.252)	(0.179)	(0.176)
HHI	-38.725**	-2.457	-130.80***	-33.736**	100.147	-0.696	-13.814	406.03***
	(15.141)	(10.603)	(37.9)	(14.572)	(90.486)	(64.733)	(54.31)	(84.881)
CISS	0.064***	0.037***	0.012	0.007	-0.224***	-0.314***	0.02	-0.143***

	(0.021)	(0.007)	(0.024)	(0.013)	(0.045)	(0.044)	(0.055)	(0.046)
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	485	452	485	474	612	525	558	491
No of banks	15	14	15	14	17	16	16	15

Table 8. Alternative specifications and method of estimation.

This table reports the estimates of the fixed effects model using data for 2007Q2–2018Q4. The dependent variable (*DEP_VAR*) represent in the columns: (1) loan growth rate, (2)-(5) quarterly loan growth rate, and (6) lending spread. In the columns (1)-(4) shows regression results estimated using fixed effects model, and in the columns (5)-(6) employing SYS-GMM model. TAX is a dummy variable equal to 1 if a bank pays the tax in a particular quarter, and 0 otherwise. All regressions include bank fixed effects, an M&A dummy, and a constant, but are not reported here for brevity. Appendix A provides the detailed definitions of the variables. Robust standard errors are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. [a]In the regression, this variable is included as log(variable).

	(1) YtY	(2) HOUSE/ STOCK	(3) ROE GROSS	(4) FILTERS	(5) GMM CREDIT	(6) GMM SPREAD
DEP_VAR_{t-1}	0.683***	0.233***	0.245***	0.243***	0.352***	0.957***
	(0.033)	(0.047)	(0.045)	(0.042)	(0.033)	(0.022)
TAX	-2.843***	-0.884**	-0.846***	-0.942**	-0.725**	0.285***
	(0.848)	(0.354)	(0.3)	(0.365)	(0.351)	(0.105)
LIQUIDITY	0.134**	0.034	0.038*	0.037*	0.032	-0.005
	(0.052)	(0.021)	(0.021)	(0.019)	(0.026)	(0.008)
ASSETS	-1.374***	-0.207	-0.184	-0.261	0.103	-0.005
	(.36)	(0.275)	(0.26)	(0.265)	(0.089)	(0.014)
ROE	0.062	0.064***		0.068***	-0.012	-0.002
	(0.066)	(0.023)		(0.024)	(0.03)	(0.009)
DEPOSITS	0.013	0.001	0.005	-0.001	0.001	0.008
	(0.052)	(0.026)	(0.025)	(0.024)	(0.012)	(0.008)
CAR	0.674***	0.189***	0.196***	0.218***	-0.032	-0.013
	(0.126)	(0.054)	(0.05)	(0.05)	(0.038)	(0.015)
NPL	-0.296**	-0.246***	-0.253***	-0.257***	-0.207***	0.02
	(0.113)	(0.043)	(0.044)	(0.047)	(0.043)	(0.013)
GDP	0.615**	1.338***	1.44***	1.463***	1.329***	-0.058**
	(0.29)	(0.277)	(0.275)	(0.271)	(0.225)	(0.024)
WIBOR	0.029	0.608**	0.717***	0.841***	0.649***	-0.062
	(0.504)	(0.246)	(0.221)	(0.235)	(0.177)	(0.054)
HHI	-474.2***	-58.485	-54.925	15.809	25.314	-20.858
	(117.379)	(75.491)	(80.908)	(76.822)	(51.437)	(16.838)
CISS	-0.507***	-0.107***	-0.158***	-0.187***	-0.181***	0.083***
	(0.112)	(0.036)	(0.038)	(0.043)	(0.037)	(0.013)
HOUSE[a]		3.043				
		(1.883)				
STOCK[a]		2.027***				
		(0.71)				
ROE_GROSS			0.26			
			(.017)			
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	994	943	945	999	943	569
No of banks	32	32	32	33	32	20
AR					0.22	0.389
Hansen test					0.15	0.11

Table 9. Heterogenous effect of the bank levy on lending.

This table reports the estimates of the fixed effects model using data for 2007Q2–2018Q4. The dependent variables (*DEP_VAR*) represent the growth rates of four types of loan portfolios in the columns: (1 and 5) non-financial loans, (2 and 6) mortgage loans, (3 and 7) consumer loans, and (4 and 8) corporate loans. TAX is a dummy variable equal to 1 if a bank pays the tax in particular quarter, and 0 otherwise. Banks' performance is measured with the ROE ratio (*ROE*) and capital adequacy ratio (*CAR*). All regressions include bank fixed effects, an M&A dummy, and a constant, but are not reported here for brevity. Appendix A provides the detailed definitions of the variables. Robust standard errors are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
DEP_VAR_{t-1}	0.236***	0.233***	0.238***	0.238***	0.236***	0.237***
	(0.046)	(0.046)	(0.047)	(0.047)	(0.046)	(0.047)
TAX	-1.008**	-1.319***	-0.988*	-1.634	-1.797	-0.782
	(0.433)	(0.453)	(0.565)	(1.265)	(1.285)	(0.625)
ASSETS	-0.203	-0.192	-0.192	-0.211	-0.177	-0.202
	(0.259)	(0.254)	(0.281)	(0.272)	(0.268)	(0.272)
ROE	0.065***	0.06**	0.064***	0.064***	0.064***	0.064***
	(0.022)	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)
LIQUIDITY	0.037*	0.038*	0.033	0.036*	0.035	0.034
	(0.021)	(0.02)	(0.021)	(0.02)	(0.021)	(0.021)
DEPOSITS	0.006	0.001	0.004	0.004	0.004	0.004
	(0.026)	(0.025)	(0.026)	(0.025)	(0.026)	(0.026)
CAR	0.191***	0.188***	0.199***	0.201***	0.185***	0.199***
	(0.049)	(0.05)	(0.051)	(0.049)	(0.056)	(0.049)
NPL	-0.245***	-0.242***	-0.241***	-0.246***	-0.242***	-0.242***
	(0.042)	(0.043)	(0.043)	(0.044)	(0.043)	(0.044)
GDP	1.44***	1.441***	1.442***	1.439***	1.437***	1.444***
	(0.274)	(0.275)	(0.274)	(0.274)	(0.273)	(0.274)
WIBOR	0.653***	0.665***	0.649***	0.654***	0.65***	0.651***
	(0.226)	(0.23)	(0.226)	(0.225)	(0.225)	(0.226)
HHI	-65.109	-60.76	-65.735	-65.275	-63.629	-65.599
	(81.584)	(83.106)	(82.129)	(81.67)	(82.225)	(82.06)
CISS	-0.165***	-0.165***	-0.165***	-0.165***	-0.166***	-0.165***
	(0.038)	(0.038)	(0.038)	(0.038)	(0.038)	(0.038)
TAX×ASSETS	0.05					
	(0.047)					
TAX×ROE		0.078**				
		(0.035)				
TAX×LIQUIDITY			0.014			
			(0.022)			
TAX×DEPOSITS				0.014		
				(0.02)		
TAX×CAR					0.072	
					(0.083)	
TAX×NPL						0.01
						(0.073)
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	943	943	943	943	943	943
No. of banks	32	32	32	32	32	32

Appendix A. The definition of the variables and their sources

Variable	Description of variables	Source
CREDIT	$Credit_{i,t}$ / $Credit_{i,t-1}$	Supervisory statistics
SPREAD	The lending interest rates on new business, expressed as a spread over the interbank rate)	
TAX	Dummy variable taking the value 1 if the bank pays a tax in particular quarter, and 0 otherwise	
TAX_RATIO	Annualized amount of bank tax $_{i,t}$ / total assets $_{i,t}$	
ASSETS	$Assets_{i,t}$ / total assets of the banking sector	
ROE	Net income divided by total equity.	
LIQUIDITY	Liquid assets $_{i,t}$ / total assets $_{it}$	
DEPOSITS	Retail deposits $_{i,t}$ / total assets $_{i,t}$	
CAR	$AT1\ capital_{i,t}$ / risk weighted $assets_{i,t}$	
NPL	$Impaired\ loans_{i,t}$ / gross loan $portfolio_{i,t}$	
GDP	The quarterly GDP dynamics	
WIBOR	Mid-point average of the Warsaw Interbank Offered Rate for different tenors	Bloomberg
HHI	Herfindahla-Hirschman index based on the total banking sector assets	National Bank of Poland
CISS	Composite Indicator of Systemic Risks (CISS)	Calculated using Bloomberg data, in accordance with the methodology explained in Kremer, Lo Duca & Holló (2012)
STOCK	The WIG stock index	Bloomberg
HOUSE	The house price index of all residential properties purchased by households	National Bank of Poland
M&A	Dummy variable taking the value 1 if the quarterly growth rate of the credit is greater than 15 percent, and 0 otherwise	Own calculations