Taxing Bank Leverage*

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Abstract

Regulators can reduce banks incentives to lever up by subsidizing equity or taxing debt. In a simple mean-variance model of portfolio selection, we show that the subsequent reduction in bank leverage in both cases goes hand-in-hand with a shift in the composition of bank assets towards loans and a decrease in bank risk. We test the model predictions by exploiting the staggered introduction of an equity subsidy and a liability tax across European countries between 2005 and 2012. We find that a one percentage point increase in the fiscal cost of bank leverage leads to an increase in the equity to total assets and the loans to assets ratios of respectively one and four percentage points. Our results suggest that taxing bank leverage can be a complementary tool to capital requirements that protects credit supply.

JEL Codes: E51, E58, G21, G28 Key words: Credit, Bank Capital, Regulation

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1 Introduction

The financial crisis of 2007-2008 demonstrated that highly levered banks can generate substantial negative externalities. As a consequence, a vigorous debate has ensued regarding the optimal level of capital requirements (Hanson et al., 2011; Admati et al., 2013). While increasing capital requirements in principle makes banks safer, it also leads to a decrease in bank lending (Aiyar et al., 2014; Fraisse et al., 2016; Jiménez et al., 2017) with adverse consequences for firms, employment, and households. High capital requirements may also spur regulatory arbitrage (Kashyap et al., 2010; Vallascas and Hagendorff, 2013; Efing, 2018; Greenwood et al., 2017). The alternative to regulating bank leverage through quantities is to regulate it through prices. This paper therefore investigates whether taxes - by making leverage more costly - can be an alternative to capital requirements that protects the supply of credit. What are the effects of a tax reform that alters the cost of leverage on bank asset allocation, credit supply and risk?

Regulators can increase the fiscal cost of leverage either by subsidizing equity or by taxing debt. In a simple mean-variance portfolio allocation model, we show that the subsequent decrease in bank leverage in both cases goes hand-in-hand with a shift in the allocation of bank assets towards loans and a decrease in total risk. We follow Rochet (1992); Freixas and Rochet (2008) and assume that banks are subject to binding capital requirements. In this framework, when regulatory risk-weights do not exactly reflect the risk of each asset, banks underinvest in the assets that are “over-weighted”, such as corporate loans. Consistent with the findings of the recent empirical literature, increasing capital requirements leads banks to decrease lending (Aiyar et al., 2014; Fraisse et al., 2016; Jiménez et al., 2017) and shift the composition of their balance sheet away from loans (Haubrich

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2The following stylized facts support the latter assumption: (1) the risk of each asset is not perfectly observable and varies across banks, and regulation is mostly at the international level; (2) capital requirements are in some dimension arbitrary: for example there are zero-risk weights for some category of assets that are clearly risky, such as sovereign bonds from the peripheral countries in Europe; (3) banks engage in regulatory arbitrage to minimize the risk weighted assets.
et al., 1993; De Jonghe et al., 2016; Gropp et al., 2019). Oppositely, taxing bank leverage, by decreasing the relative cost of equity, partly offsets the distortions induced by capital requirements. When the fiscal cost of leverage increases, banks not only decrease leverage, but also rebalance their assets towards corporate loans while decreasing total risk.

To empirically test the model predictions, we first exploit the introduction of an *Allowance for Corporate Equity* (ACE) in Belgium in 2005 that increased the fiscal cost of leverage by neutralizing the interest tax shield. With an ACE, banks can deduct a notional interest on the book value of their equity from their taxable income. The introduction of the Belgian ACE offers a nice quasi-experimental set-up to investigate the effects of an increase in the fiscal cost of leverage on bank assets composition for the following reasons: (1) it is not simultaneous to any other major tax reforms; (2) it applied only to a subset of banks subject to the same European regulatory framework; (3) it did not affect the demand for credit from Belgian firms; (4) it applied to banks that are actively lending abroad, allowing us to investigate the effect of the reforms on bank lending in markets that these tax reforms did not affect.

We show that the decrease in bank leverage following the introduction of the Belgian ACE documented in Schepens (2016) came with a noteworthy shift in the composition of their assets towards loans. A 1 percentage point (pp) increase in the fiscal cost of bank leverage following the implementation of the ACE lead to a 1 pp increase in the equity to total assets ratio and a 7 pp increase in the loans to assets ratio of banks for which capital requirements are binding. These are potentially large effects, given that, for instance, the transition from Basel II to Basel III is supposed to raise minimum capital requirements from 4.5% to 6% over the course of six years. A 7 pp increase in the loan to assets ratio of Belgian banks implies an additional 14 billion of credit supply, i.e. 3.5% of the GDP in Belgium in 2005. We also find that while total assets are stable, the average regulatory

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3 The fiscal cost of leverage is the increase in the tax rate (or decrease to the tax subsidy) applied to bank leverage when computing the WACC. Increasing the fiscal cost of leverage by 1 pp is equivalent to a 1% tax on bank liabilities or a full ACE when the tax rate is 33% and the notional interest is 3%. When the fiscal cost of leverage increases by 1 pp, the weighted average cost of capital increases by 1 basis point for each percentage point of leverage.
risk-weight is increasing. Hence banks substitute low-weighted assets with high-weighted assets. We obtain these results in a difference-in-differences setting where the control group of banks is obtained through propensity score matching. The results hold in a large set of alternative specifications - such as when we vary the parameters of the matching procedure or include size × year and bank × leverage fixed effects. The effect is mostly concentrated on banks with ex-ante low ratios of equity to total assets, i.e. with the lowest direct effect of the subsidy on their cost of capital. This mitigates the concern that the change in the bank asset mix is only due to a revenue effect, where banks transfer the equity subsidy to firms by offering loans at a lower rate.

We then confirm that the change in the asset mix of banks triggered by the introduction of the ACE is a supply effect that improved firm access to credit, in other words that this is not driven by a higher demand for credit. We can disentangle credit supply from demand by using loan level-data from Germany. We focus on the German loan market as (1) no German firms are affected by the introduction of the ACE; (2) a subset of Belgian banks are lending actively in Germany; and, (3) the German economy is strong and stable, which allows to absorb a positive supply shock. We find that a 1 pp increase in the fiscal cost of bank leverage leads banks to increase loan growth by 20 pp. We again follow a difference-in-differences approach to compare lending by treated versus control banks before and after each reform. We control for bank, bank-firm relationship and firm characteristics, and in our favorite set of specifications we saturate with firm fixed effects to account for all heterogeneity in the quantity and quality of firm-specific demand for credit \cite{Khwaja and Mian 2005}. The magnitude of the effect is relatively similar when restricting the sample to foreign lending only, or at the extensive margin of lending.

Ultimately, the degree to which an increase in credit supply from affected banks implies real effects at the firm level depends on the extent to which bank relationships matter for firm access to credit. We thus study whether the increase in

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\[\text{Our initial sample includes the fifteen European countries with the highest total banking assets: Austria, Belgium, Denmark, France, Germany, Italy, Ireland, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and United Kingdom.}\]
lending by Belgian banks had real effects on firms. We find that German firms in a relationship with Belgian banks before the tax reform exhibit a higher asset growth after the tax reform.

To increase the fiscal cost of leverage, the alternative to subsidizing equity is to tax bank debt. We therefore investigate the staggered introduction of a Liability Tax across European countries from 2010 to 2012 that applied to bank total liabilities net of equity and insured deposits. This tax reform only applied to banks, and only to a subset of banks under the same banking regulation, i.e., in the European Banking Union. Six countries of the Banking Union applied the liability tax: Austria, Belgium, Germany, the Netherlands, Portugal and Slovakia. The tax rate, 3 basis points on average in our sample, is significant relative to the funding rates of banks during this period, which amounted to 1% in the Euro Zone.

Consistent with our findings on the ACE, and in line with our model predictions, we find that banks not only decreased leverage following the implementation of the Liability Tax, as shown by Devereux et al. (2017), but also significantly shifted the composition of their assets towards loans. We restrict our analysis to the banks from the Banking Union, we exclude banks that were stress-tested in 2011, and define the control group of banks through propensity score matching. The results hold when we vary the parameters of the matching procedure, when we exclude GIIPS countries, small banks, or include size × year and bank × leverage fixed effects.

One concern would be that our results are driven by bank specific characteristics that our controls do not capture. We therefore turn to an alternative specification that includes bank × year fixed effects by focusing on the implementation of the Liability Tax in Slovakia. In Slovakia, more than 80% of the banking assets are held by foreign banks. We therefore compare the behaviour of the Slovakian subsidiaries to other subsidiaries of the same banks in the same geographical areas. We find that the 0.4% tax on the liabilities of Slovakian banks lead to an increase in the equity to assets ratio of 1.2 pp and of the loans to assets ratio of 7.3 pp. The magnitude of the effect is larger than with the ACE, but funding costs are
also lower for banks during this period.

In a final step, we investigate empirically the impact of both tax reforms - the ACE and the Liability Tax - on bank risk-taking. This is the main empirical challenge, as our main theoretical assumption is that the regulators’ risk measures - the regulatory ratios - are binding and do not perfectly reflect the bank asset risk. Consistent with the model predictions, we hence find that regulatory ratios are unchanged after the implementation of the tax reforms. Conversely, the ratio of risk-weighted assets to total assets is increasing, as banks switch the composition of their assets to the assets with the highest regulatory risk weights. We, therefore, turn to alternative measures of risk: the Z-score and the ratio of impaired loans to total loans. Both indicate a decrease in the bank total risk. When exploiting firm level data from the Bundesbank, we also find no evidence that Belgian banks extended lending to riskier firms. Overall, we find that a decrease in leverage following a change in the fiscal cost of leverage simultaneously leads to a higher leverage ratio, relatively higher lending and a decrease in bank total risk. Our results, therefore, suggest that fiscal policy could be a useful complementary tool to control bank leverage while maintaining credit supply.

This paper connects to the literature that investigates the optimal bank capital regulation. The recent financial crisis has brought to the forefront the discussion of whether the capital requirements of banks should be increased (Admati et al. (2010)). On one side, Hellmann et al. (2000), Repullo (2004), and Morrison and White (2005) argue that stringent capital regulation can induce prudent behavior by banks. On the other side, Diamond and Rajan (2000), Diamond and Rajan (2001), and DeAngelo and Stulz (2013) provide theoretical evidence that tightening capital requirements may distort banks’ incentives. Hanson, Kashyap, and Stein (2011), Gropp et al. (2019) and Juelsrud and Wold (ming) show how an increase in capital requirements leads banks to shrink assets rather than raising new equity. Our results suggest that increasing the fiscal cost of leverage could both mitigate this problem and partly offset the distortions induces by capital requirements.

The paper also adds to the literature that identifies the real effects of bank cap-

5 Hanson, Kashyap, and Stein (2011) suggest targeting the absolute amount of new capital that has to be raised instead of targeting the capital ratio.
ital regulations. While the existing literature has focused on the effects of capital requirements on bank lending (Kashyap et al., 2010; Aiyar et al., 2014; Gornall and Strebulaev, 2018; Fraisse et al., 2014; Jiménez et al., 2017), we investigate the effect of changes in the fiscal cost of leverage. We, therefore, provide the first evidence that taxes can give banks incentives to simultaneously decrease leverage and increase credit supply - with consequent implications for investment and growth.

More broadly, our paper adds to the literature on whether taxes can be complementary to quantitative limits to address negative externalities (Cochrane, 2014; Roe and Tröge, 2016). There are three reasons why taxes might be an efficient complementary tool to quantitative regulation. First, with taxes, banks would endogenize the social cost of leverage rather than arbitraging regulation to reduce its cost. Second, regulators could infer from taxes the marginal cost of holding equity for banks. Third, a single tax rate might be a simple alternative to the complex set of regulatory ratios defined in Basel 3, which aim at improving the alignment of capital requirements to the risk of each asset (Greenwood et al., 2017). In many settings, such as in environmental policy making, regulation through prices is found to complement or even dominate regulation through quantities (Pizer, 2002; Hoel and Karp, 2002).

Our findings could also complement the discussion on the central bank tools to stimulate lending. In an environment where interest rates are low, the ACE could be an alternative to a lax monetary policy to stimulate lending by banks in the next financial crisis. While there is ample evidence that monetary tightening affects bank lending (Kashyap and Stein, 2000; Campello, 2002), lowering interest rates proved to be less effective. This lead central banks to use quantitative easing during the last financial crisis. But the effectiveness of quantitative easing has been a topic of vivid debate: While quantitative easing might have fostered bank lending (Rodyansky, Darmouni 2017), quantitative easing might also have fueled asset bubbles. An equity subsidy could allow banks to expand lending while decreasing bank leverage and total risk.

Finally, our study complements the literature on the impact of taxation on bank capital structure (De Mooij and Keen, 2016; Schepens, 2016; Gu et al., 2015).
Gambacorta et al. (2017), Devereux et al. (2017), intermediation costs (Capelle-Blancard and Havrylchyk, 2017), deposit rates (Buch et al. 2016) and lending (Smolyansky 2018), while an increasing number of countries is considering implementing an ACE or Liability Tax.

The remainder of our paper proceeds as follows. Section 2 presents a simple conceptual framework, Section 3 the effects of the implementation of the ACE, Section 4 of the Liability Tax. Section 5 concludes.

2 Conceptual Framework

We follow Rochet (1992) and Freixas and Rochet (2008) to investigate the effects of a change in the fiscal cost of leverage on bank asset composition, capital structure and risk.

It is a static model with only two dates: $t = 0$, when the bank chooses the composition of its portfolio; and $t = 1$, where all assets and liabilities are liquidated. The bank can invest in a set of 2 possible assets, or groups of assets: corporate loans, denoted $L$, and securities, denoted $S$. $(\tilde{r}_L; \tilde{r}_S)$ is the vector of random returns with mean $\mu = (\mu_L; \mu_S)$ and with invertible variance-covariance matrix $\Sigma$. We assume that on average corporate loans are riskier than securities so that $\mu_L > \mu_S$. $x = (x_L; x_S)$ is the vector of dollar holdings.

There are only two liabilities: equity capital $E$ and deposits $D$. Let $E$ be the dollar amount of equity held by the bank. The return on equity expected by shareholders is exogenous and amounts to $R$, with $R > 0$, while the return on deposits is 0. We here assume that equity is relatively costly to banks, which is consistent with the finding that banks cut assets when they face a capital shock (Peek and Rosengreen, 1997). The relatively high cost of equity can be related to the premium that investors pay to hold bank debt (Gorton, 2010; Gorton and

\[
\Sigma = \begin{bmatrix}
\sigma^2_L & \rho \sigma_L \sigma_S \\
\rho \sigma_L \sigma_S & \sigma^2_S 
\end{bmatrix} \quad \Sigma^{-1} = \frac{1}{1-\rho^2} \begin{bmatrix}
\frac{1}{\sigma^2_L} & -\frac{\rho}{\sigma_L \sigma_S} \\
-\frac{\rho}{\sigma_L \sigma_S} & \frac{1}{\sigma^2_S}
\end{bmatrix}
\]
and to the information sensitivity of equity, which makes it costly to raise (Myers and Majluf, 1984).

The bank is subject to capital regulation. The regulator defines regulatory risk weights \( w = (w_L; w_S) \) and requires the ratio of equity to risk-weighted assets \( RWA \) - or the Core Tier 1 Ratio \( CT_1 \) - to be higher than \( k \). Thus, the bank is constrained to satisfy

\[
\begin{align*}
    k & \leq CT_1 \\
    \Leftrightarrow kRWA & \leq E \\
    \Leftrightarrow kx^Tw & \leq E.
\end{align*}
\]

We explore the effects of increasing the fiscal cost of leverage when the regulatory risk-weights do not exactly reflect the riskiness of each asset, i.e., when corporate loans are “over-weighted”. We therefore introduce \( \alpha_L > 0 \) and \( \alpha_S > 0 \), such that

\[
\begin{align*}
    w_L &= \alpha_L\mu_L \\
    w_S &= \alpha_S\mu_S
\end{align*}
\]

The traditional CAPM would require that \( \alpha_L = \alpha_S \) for the regulatory risk weights to reflect the riskiness of each asset.\(^8\) Oppositely, if \( \alpha_L > \alpha_S \), corporate loans are “overweighted” relatively to securities.

There are two main reasons why corporate loans might be overweighted in the formula that defines capital requirements compared to securities. First, the average regulatory risk weight on securities is close to 0, and is even exactly 0 for European sovereign bonds, while it is roughly between 45 and 60% for corporate loans under Basel 2. Second, reaching for yield, i.e. the fact that within each asset category banks pick the riskiest assets to get higher returns, might be less efficient with corporate loans. Moral hazard and adverse selection limit the level of interest rate banks can charge on small and medium companies that consequently largely suffer from credit rationing (Stiglitz and Weiss, 1981; Holmstrom and Tirole, 1997).

\(^8\)In a competitive market the return-vector \( \mu \) is colinear to the risk of each asset
2.1 Benchmark

The bank's profit in period 1 is

\[ \tilde{\Pi} = x^T (1 + \tilde{r}) - D - (1 + R)E. \]  

(1)

We introduce the accounting equation giving the total of the balance sheet at date \( t=0 \), \( x_1 + x_2 = D + E \) and obtain

\[ \tilde{\Pi} = x^T (1 + \tilde{r}) - x_1 - x_2 - R \times E \]

\[ \Leftrightarrow \tilde{\Pi} = x^T \tilde{r} - R \times E. \]

We assume that the bank behaves as a mean-variance investor with risk aversion \( \gamma \). The objective function \( V \) of the bank is

\[ V = \mathbb{E}(\tilde{\Pi}) - \frac{\gamma}{2} \text{Var}(\tilde{\Pi}), \]

(2)

where the level of equity is constrained by equation (??). The Lagrangian the bank maximizes is, therefore,

\[ L = x^T \mu - \frac{\gamma}{2} x^T \Sigma x - k \lambda x^T w + E[\lambda - R]. \]

(3)

The bank chooses \( x \) to maximize \( L \). Therefore, the gradient of \( L \) with respect to \( x \) is equal to 0. This implies

\[ \nabla_x L = \mu - \gamma \Sigma x - k \lambda w = 0. \]

The asset portfolio \( x \) the bank chooses satisfies

\[ x = (\gamma \Sigma)^{-1}(\mu - k \lambda w). \]

The bank also chooses \( E \) to maximize \( L \). Therefore, the partial derivative of \( L \)
with respect to $E$ is equal to 0

$$\frac{\partial L}{\partial E} = \lambda - R = 0,$$

which implies

$$x = (\gamma \Sigma)^{-1}(\mu - kRw), \quad (4)$$

and

$$E = kx^Tw = k \times RWA. \quad (5)$$

In the rest of the model, we derive equations for the special case where $\rho = 0$, i.e., the correlation between loan and security returns is null, for tractability reasons. We show in the online appendix that all the results hold when $\rho > 0$. The explicit solutions is

$$\begin{align*}
  x_L &= \frac{\mu_L - kRw}{\gamma \sigma_L^2} \\
  x_S &= \frac{\mu_S - kRw}{\gamma \sigma_S^2}
\end{align*}$$

If we substitute $(w_L; w_S)$ with $(\alpha_L \mu_L; \alpha_S \mu_S)$, it becomes

$$\begin{align*}
  x_L &= \frac{\mu_L - k\alpha_L \mu_L}{\gamma \sigma_L^2} \\
  x_S &= \frac{\mu_S - k\alpha_S \mu_S}{\gamma \sigma_S^2}
\end{align*}$$

We now introduce the Markowitz portfolio $x^M = (\frac{\mu_L}{\gamma \sigma_L^2}; \frac{\mu_S}{\gamma \sigma_S^2})$, i.e., the portfolio the bank chooses in the absence of capital constraints, and obtain

$$\begin{align*}
  x_L &= (1 - k\alpha_L)x^M_L \\
  x_S &= (1 - k\alpha_S)x^M_S
\end{align*}$$

The bank asset mix can be characterised by the ratio $\frac{x_L}{x_S}$ such that

$$\frac{x_L}{x_S} = \frac{1 - k\alpha_L x^M_L}{1 - k\alpha_S x^M_S}, \quad (6)$$
We have
\[
\frac{\partial (x_L/x_S)}{\partial k} = - \frac{R(\alpha_L - \alpha_S) x^M_L}{(1 - kR\alpha_S)^2 x^M_S}.
\] (7)

Hence,
\[
\frac{\partial (x_L/x_S)}{\partial k} < 0 \Leftrightarrow \alpha_L > \alpha_S
\] (8)

When corporate loans are “over-weighted”, i.e., \( \alpha_L > \alpha_S \), an increase in the level of capital requirements \( k \) leads banks to reallocate their assets away from corporate loans. Hence, the average risk weight of their asset decreases, which implies \( \frac{\partial (RWA/TA)}{\partial k} < 0 \). We also have
\[
\frac{\partial (x_L + x_S)}{\partial k} = -R\alpha_L x^M_L - R\alpha_S x^M_S < 0,
\] (9)

The bank’s total portfolio shrinks when \( k \) increases, as the additional cost of binding capital reduces the effective return of each asset. The fact that the bank both reduces its amount of assets and decreases the share of loans in its balance sheet implies that \( \frac{\partial x_L}{\partial k} < 0 \). In words, the bank’s lending decreases.

Finally, when capital requirements are binding, the bank Core Tier 1 ratio \( CT^1 \) exactly equals \( k \) and \( E = k \times (w_L x_L + w_S x_S) \). The ratio of equity to total assets \( ETA \) is therefore
\[
ETA = \frac{E}{x_L + x_k} = k \frac{w_L x_L + w_S x_S}{x_L + x_S} = k \frac{RWA}{TA}
\]

We show in the online appendix that
\[
\frac{\partial ETA}{\partial k} < 1.
\] (10)

The equity to total assets ratio increases less than the regulatory ratio \( CT^1 \) when \( k \) increases, as \( \frac{\partial CT^1}{\partial k} = 1 \).

All these results are consistent with an abundant literature showing empirically that increasing capital requirements leads banks to: (1) shift the composition of their balance sheet away from loans, hence decreasing the average risk weight of
their assets (Haubrich et al., 1993; De Jonghe et al., 2016; Gropp et al., 2019; Juelsrud and Wold, ming); (2) reduce lending to firms (Aiyar et al., 2014; Fraisse et al., ming; Jiménez et al., 2017); and (3) increase less their equity to total assets ratio than their CT1 ratio (Adrian and Shin, RFS 2014).

2.2 Taxing Bank Leverage: The Allowance for Corporate Equity

We now incorporate taxes and investigate the effect of increasing the fiscal cost of leverage through an Allowance for Corporate Equity, or ACE. Let Θ be the income tax rate. In the presence of an ACE, the bank can deduct from the income before taxes a notional interest \( \tau_E \) applied to the book value of equity \( E \). Taxes, therefore, amount to \( \Theta(x^T \hat{r} - \tau_E \times E) \). The bank’s WACC is \( (1 - L) \times (R - \Theta \tau_E) \), where \( L = \frac{D}{E+D} \). The fiscal cost of leverage, which we define as the increase in the WACC resulting from a 1 percentage point in leverage related to taxes, amounts to \( \Theta \tau_E \).

The bank’s after tax profit in period 1 is now:

\[
\tilde{\Pi} = (1 - \Theta)x^T \hat{r} - E[R - \Theta \tau_E]
\]

and the Lagrangian that the bank maximizes becomes

\[
\mathcal{L} = x^T \mu (1 - \Theta) - \frac{\gamma}{2} (1 - \Theta)^2 x^T \Sigma x - \lambda k w^T x + E[\Theta \tau_E + \lambda - R],
\]

The bank chooses \( x \) and \( E \) to maximize \( \mathcal{L} \), which implies

\[
\nabla_x \mathcal{L} = \mu (1 - \Theta) - \gamma (1 - \Theta)^2 \Sigma x - k \lambda w = 0,
\]

and

\[
\frac{\partial \mathcal{L}}{\partial E} = \Theta \tau_E + \lambda - R = 0.
\]
The asset portfolio $x$ now satisfies:

$$x = (\gamma(1 - \Theta)^2 \Sigma)^{-1} (\mu(1 - \Theta) - (R - \Theta \tau_E) k w) \tag{11}$$

### 2.2.1 Bank Asset Mix

How is the asset allocation affected by an increase in the equity subsidy rate $\tau_E$? If we substitute $(w_L; w_S)$ with $(\alpha_L \mu_L; \alpha_S \mu_S)$ in (11) and plug in the portfolio $x^M = (\frac{\alpha_L}{\gamma_L}; \frac{\alpha_S}{\gamma_S})$, the bank asset mix is characterized by the ratio

$$\frac{x_L}{x_S} = \frac{1 - \Theta - k(R - \Theta \tau_E) \alpha_L x^M_L}{1 - \Theta - k(R - \Theta \tau_E) \alpha_S x^M_S}.$$

This implies

$$\frac{\partial (x_L/x_S)}{\partial \tau_E} = \frac{k \Theta (\alpha_L - \alpha_S)}{(1 - \Theta - k(R - \Theta \tau_E) \alpha_S)^2 x^M_S}. \tag{12}$$

We observe from (12) that the asset mix of banks is unaffected by the ACE if and only if $\alpha_L = \alpha_S$. However, if $\alpha_L > \alpha_S$, i.e., if corporate loans are “over-weighted”, then the bank shifts the composition of its assets towards loans. Because loans have the highest risk weights, i.e., $w_L > w_S$, the average risk weights - measured by the ratio of risk weighted assets $RWA$ to total assets $TA \frac{RWA}{TA}$ - increases. Hence

$$\frac{\partial (RWA/TA)}{\partial \tau_E} > 0.$$

Finally, \begin{equation}
\frac{\partial (x_L + x_S)}{\partial \tau_E} = \frac{\Theta k \alpha_L}{(1 - \Theta)^2} x^M_L + \frac{\Theta k \alpha_S}{(1 - \Theta)^2} x^M_S > 0, \tag{13}
\end{equation}
which implies that the bank’s total portfolio size increases.

**Proposition 1** When the tax subsidy $\tau_E$ increases and $\alpha_L > \alpha_S$, the bank re-balances its portfolio towards loans. The ratios and loans to assets, the ratio of risk-weighted assets to total assets, and bank lending increase.

The mechanism is the following: the ACE, by decreasing the cost of equity,
decreases the cost of required capital for each asset, hence increasing their effective
return. The effect, however, is larger on the assets that are over-weighted, i.e.,
corporate loans, leading to both an increase in the size of the bank’s portfolio and
a shift in its composition. We also show in the online appendix that \( \frac{\partial (x_L/x_S)}{\partial k \partial \tau_E} > 0 \),
which implies that the ACE will partly offset the distortionary effects of increasing
capital requirements when \( \alpha_L > \alpha_S \).

2.2.2 Bank Capital Structure

Capital requirements are binding, the ratio of equity to total assets \( ETA \) is there-
fore defined by

\[
ETA = \frac{E}{x_L + x_k} = k \frac{w_L x_L + w_S x_S}{x_L + x_S} = k \frac{RWA}{TA}
\]

We hence have

\[
\frac{\partial ETA}{\partial \tau_E} = k \frac{\partial RWA/TA}{\partial \tau_E} > 0.
\] (14)

Proposition 2 When \( \tau_E \) increases and \( \alpha_L > \alpha_S \), the equity to total assets ratio
increases.

2.2.3 Bank Total Risk

We consider as a measure of the bank risk the ratio \( 1/\Omega \), \( \Omega \) being the ratio of bank
equity to the sum of the exact risk-weighted assets, under the assumption that the
asset exact risk is colinear to the vector of returns \( \mu = (\mu_L, \mu_S) \). Hence :

\[
\Omega = k \frac{\alpha_L \mu_L x_L + \alpha_S \mu_S x_S}{\mu_L x_L + \mu_S x_S}.
\]

We show in the online appendix that, if \( \alpha_L > \alpha_S \), \( \frac{\partial \Omega}{\partial \tau_E} > 0 \), i.e., bank total
risk decreases when \( \tau_E \) increases. The level of equity increases more than the exact
risk-weighted portfolio, as the formula that defines the required level of equity puts
more weight on the assets that increase the most due to the portfolio rebalancing,
i.e. corporate loans.
Proposition 3 When the tax subsidy $\tau_E$ increases and $\alpha_L > \alpha_S$, the bank total risk decreases.

2.3 Taxing Bank Leverage: The Liability Tax

We now investigate the effects of increasing the fiscal cost of leverage through a Liability Tax. With the Liability Tax, a rate $\tau_{LT}$ is applied to bank liabilities minus equity. The bank’s WACC becomes $(1 - L) \times R + L \times \tau_{LT}$ and the fiscal cost of leverage is $\tau_{LT}$. The taxes the bank pays amount to $\tau_{LT}(x_1 + x_2 - E)$. Hence, the Liability Tax affects the behavior of banks by increasing the cost of capital while decreasing the relative cost of equity.

The bank after tax profit is now

$$\tilde{\Pi} = x^T(\tilde{r} - \tau_{LT}) - E[R - \tau_{LT}]^9$$

The Lagrangian that the bank maximizes becomes

$$L = x^T(\mu - \tau_{LT}) - \frac{\gamma}{2}x^T\Sigma x - \lambda kw^Tx + E[\tau_{LT} + \lambda - R].$$

The asset portfolio $x$ now satisfies

$$x = (\gamma \Sigma)^{-1}(\mu - \tau_{LT} - (R - \tau_{LT})kw).$$ (15)

2.3.1 Bank Asset Mix

How is the asset allocation affected by an increase in the tax rate $\tau_{LT}$? If we substitute $(w_L; w_S)$ with $(\alpha_L \mu_L; \alpha_S \mu_S)$ in (15) and plug in the portfolio $x^M$, the asset mix of banks is characterized by

$$x_L = \frac{1 - \frac{\tau_{LT}}{\mu_L} - k(R - \tau_{LT})\alpha_L x^M_L}{1 - \frac{\tau_{LT}}{\mu_S} - k(R - \tau_{LT})\alpha_S x^M_S}.$$ (16)

For tractability reasons, we here ignore the corporate tax rate $\Theta$, but results are unchanged when we include it.
We have
\[
\frac{\partial (x_L/x_S)}{\partial \tau_{LT}} = \frac{\sigma^2_S [\mu_L (1 - Rk\alpha_L) - \mu_S (1 - Rk\alpha_S) + k\mu_L\mu_S (\alpha_L - \alpha_S)]}{(\sigma_L (\mu_S - \tau_{LT} - k(R - \tau_{LT}) w_S))^2}
\]

We show in the online appendix that \(\alpha_L > \alpha_S \Rightarrow \frac{\partial (x_L/x_S)}{\partial \tau_{LT}} > 0\). Hence, the bank shifts the composition of its assets towards corporate loans when \(\alpha_L > \alpha_S\). Two effects combine. First, the relative cost of the binding capital requirements decreases more for corporate loans, as they are relatively “over-weighted”. Second, the effective return of risky assets is proportionally less affected by an increase in \(\tau_{LT}\). As a result, the ratio of risk-weighted assets to total assets increases, i.e., \(\frac{\partial (RWA/TA)}{\partial \tau_{LT}} > 0\). We also have
\[
\frac{\partial (x_L + x_S)}{\partial \tau_{LT}} < 0,
\]

We show in the online appendix that if \(\rho\) is large enough, lending might increase as banks will strongly substitute securities with loans.

**Proposition 4** When the tax rate on bank liabilities \(\tau_{LT}\) increases and \(\alpha_L > \alpha_S\), banks rebalance their portfolio towards corporate loans, and the ratio of risk weighted assets to total assets increases. Lending might also increase if the correlation between the returns of corporate loans and securities is high enough.

### 2.3.2 Bank Capital Structure

Capital requirements are binding, the ratio of equity to total assets \(ETA\) is therefore defined by
\[
ETA = k \frac{RWA}{TA}
\]

We hence have
\[
\frac{\partial ETA}{\partial \tau_{LT}} = k \frac{\partial RWA/TA}{\partial \tau_{LT}} > 0.
\]

**Proposition 5** When \(\tau_{LT}\) increases and \(\alpha_L > \alpha_S\), the equity to total assets ratio increases.
We show in the online appendix that if $\rho$ is large enough, the level of equity $E$ might also increase.

2.3.3 The Effect of Bank Total Risk

Using the same measure of bank risk $1/\Theta$, we show that the bank total risk decreases when $\tau_{LT}$ increases. The level of equity decreases less than the exact risk-weighted portfolio, as the formula puts excessive weight on the asset that decreases the least.

**Proposition 6** When $\tau_{LT}$ increases and $\alpha_L > \alpha_S$, the bank total risk decreases.

2.4 Empirical Predictions

Table I summarizes the testable empirical predictions that our model generates about the effects of increasing capital requirements (column 1), the implementation of an ACE (column 2), and a Liability Tax (column 3) on the bank asset allocation, capital structure and risk. The abundant findings from the empirical literature on the real effects of increasing capital requirements are in line with the model predictions given in Column (1), which support our model assumptions.\textsuperscript{10}

When a Liability Tax or an ACE are implemented, one should observe that:

1. **Asset Allocation**: The loans to assets ratio increases, as well as the ratio of risk-weighted assets to total assets.

2. **Bank Lending**: Lending increases with an ACE and might also increase with the Liability Tax if there is a strong substitution with other types of assets.

3. **Capital Structure**: The equity to assets ratio increases, while the CT1 ratio stays constant. The level of equity increases with the ACE, while the effect is unclear with the Liability Tax.

4. **Risk**: Bank total risk decreases.

\textsuperscript{10}All the predictions would be almost opposite in a Modigliani-Miller world.
3 Increasing the Fiscal Cost of Leverage with an ACE: Evidence from Belgium (2005)

We investigate the effects of taxing bank leverage on bank capital structure and asset allocation by exploiting the introduction of an ACE in Belgium in 2005.

3.1 Background

In June 2005, two years after the European Commission put an end to a unique Belgian fiscal advantage, the Belgian parliament voted the implementation of an ACE. The Belgian ACE offers a clean experimental set-up to investigate the effect of an increase in the fiscal cost of leverage on bank activities for the following reasons.

First, the Belgian ACE is a “full” ACE: 1) The ACE base is the full equity stock, i.e., common equity and retained earnings; 2) the ACE rate $\tau_E$ is based on the average rate on 10-year bonds the preceding year with some restrictions; 3) the “notional interest” is fully deducted from taxes.11 We, therefore, provide evidence of the effects on banks of a direct equity subsidy analogous to the widespread debt subsidy in traditional tax systems.12

Second, the Belgian ACE did not coincide with any other major fiscal or macroeconomic change. This is the fear of losing profit centers to other countries following the dismantlement of a fiscal advantage by the European Union, the coordination center regime, that lead to the ACE tax reform. The coordination center regime was implemented in 1983 to attract subsidiaries of non-Belgian multinationals with a fixed tax rate, ranging from 4 to 10%, based on expenses less

11 The notional interest rate was 3.4% for the 2006 accounting year, and 3.8%, 4.3%, 4.5%, 3.8%, and 3.5 %, respectively, for years 2007 to 2011. Faced with the budgetary consequences of the financial crisis, the Belgian government capped the NID rate at 3.8% for both 2010 and 2011. If the initial NID formula had been applied, the 2011 NID rate would have been 4.1%.

12 While there has been other experiences of ACE in various countries, for example, in Croatia from 1994 to 2000, in Italy from 1997 to 2003 and since 2012, in Austria from 2000 to 2004, in Liechtenstein since 2011, in Portugal from 2010 to 2013 and in Cyprus since 2015, Belgium is the only country where both a full ACE was implemented and the data are available to investigate its effect. In Italy, for example, the tax base only concerned new equity, while in Austria, a reduced corporate tax rate was applied on the notional return on equity. The Croatian ACE is close to a full ACE but no data is available to investigate its effect on banks (De Mooij and Devereux 2011; Hebous and Ruf 2017).
financial and salary costs rather than on profits. While at the time the European Commission approved this tax regime, the European Commission decided in 2003 that this was incompatible with EU state aid rules. The decision of the European Commission was not enacted to address changing macroeconomic conditions or a domestic fiscal challenge, a common feature of the majority of tax reforms. The introduction of the ACE only coincided with the elimination of a 0.5% tax on new equity issuance, but this concurrent elimination had only a minor economic importance compared to the recurrent tax benefits from the ACE.

Third, even if the Belgian ACE also concerned firms, it had almost no effects on firm demand for loans. On the one hand, two measures that were favoring the use of equity financing for small firms were repealed concurrently, so that incentives to issue equity instead of debt are unchanged for these small firms. Panier et al. (2015) show that, because of this concurrent repeal, only firms with equity value above €1.3 million had higher incentives to decrease leverage after the implementation of the ACE. On the other hand, while large firms were affected by the ACE, they increased their level of equity without decreasing their debt (Panier et al., 2015).

Finally, in 2006, the Belgian economy was growing steadily and in line with the other European countries we include in our control group (see Section C in the Online Appendix).

Back of the envelope calculations suggest that the Belgian ACE directly increases the fiscal cost of leverage by 1.1 percentage points. Let $\Theta$ be the tax rate, $\tau_E$ be the notional interest applied to equity and deducted from taxes and $L$ the bank leverage, with $L = \frac{D}{D+E}$. The cost of capital is decreased by $(1-L) \times \Theta \times \tau_E$. The fiscal cost of leverage increases, therefore, by 1.1 percentage points as the tax rate is 35% and the notional rate applied in 2006 is 3.4%. The resulting decrease in the cost of capital amounts to 7.5 basis points when we consider the average leverage ratio of Belgian banks at this period.

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13 These two measures where a) a (capped) tax credit to firms that increased their equity base that amounted to 7.5% of the equity increase, capped at €19,850; and b) a (also capped) tax deduction for investment funded with equity. This tax deduction regime, the “untaxed investment reserve”, allowed firms to deduct up to €18,750 for investments funded with retained earnings.
The Belgian ACE regime has mechanically weakened over the last years, with the progressive reduction of the long term rates that drive the ACE notional rate. Starting in 2012, the interest rate deduction was capped at 3%, and in 2013 the limit was further revised to 2.7%. In 2015, the rate was down to 1.63% and decreased down to 0.7% in 2018. In 2017, the ACE base is reduced only to the new equity.

3.2 The Effects on Bank Asset Allocation, Capital Structure and Risk

3.2.1 Data

Sample Construction

Bank financial data is from the Bureau van Dijk Bankscope database. We select all commercial, savings and cooperative banks from the fifteen largest banking sectors in Europe, i.e., Austria, Belgium, Denmark, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Switzerland, Spain, Sweden, and United Kingdom. We restrict our analysis to these fifteen countries because we want banks that face similar credit markets and macroeconomic conditions. We also do not restrict our analysis to the EU or the Eurozone, because we want to include UK and Swiss banks as they are comparable in size and business models to other European banks, and because they lend actively in Germany (Table X in the online appendix). We also know that the quality of the coverage of these 15 European countries in Bankscope is good (Duprey and Lê 2016). We keep all banks that have data available over the 1996-2014 period.

We build our final database on bank financial statements the following way. First, Bankscope collects financial statements with various consolidation status. We, therefore, keep only consolidated statements when available. Second, Bankscope also includes balance sheet information on bank subsidiaries, with no information on the ownership structure of a bank. For each country, we therefore select manually the bank we keep in the sample and drop subsidiaries to avoid double counting. We also drop non-for-profit banks, such as German and Italian cooperative banks.
Finally, we convert data into constant 2007 dollars.

Finally, we also employ a number of country-level control variables including inflation rates, real GDP growth rates, and GDP per capita from Eurostat.

**Variables**

Table III shows summary statistics for our main variables of interest for treated banks and control banks in, respectively, the left-hand and middle parts of the table for each policy reform we consider. The main variables of interest are the leverage ratio, defined as total equity over total assets, the loan ratio, defined as total loans over total assets, and the risk-weighted capital ratio, defined as equity over the risk-weighted assets. The bank-specific characteristics that we use as control variables in our regressions include bank size, defined as the log of total assets, return on assets, and the non-interest income share.

To investigate the effects of changes in the fiscal cost of leverage on bank risk, we break down bank risk into three components: funding risk, asset risk and total risk. The leverage ratio measures the funding risk. We use the ratio of risk-weighted assets to total assets as a measure of asset risk even if we know that regulatory risk weights do not perfectly reflect the risk of each asset. Finally, we use the Z-score and the ratio of the leverage ratio to the standard deviation of returns on assets as measures of bank total risk.

INSERT TABLE III

3.2.2 Building a Control Group of Banks: Propensity Score Matching

For each policy reform, we estimate the effect on bank balance sheet composition by comparing treated banks to a control group of European banks that we obtain through propensity score matching (Angrist and Krueger 1999; Roberts and Whited 2013; Schepens 2016). We compute propensity scores based on the following bank characteristics in the pre-treatment period: Total assets in log, contemporaneous and lagged leverage ratio, the loan ratio and the growth rates of the leverage ratio, the loan ratio, and total assets. We also include the GDP per capita growth rate as a macroeconomic variable. We include growth rates to
make it more likely that both treated and control banks are in a parallel trend in the pre-treatment period.

The matching procedure is done with replacement, which means that each control bank can be used as a neighbor for several treated banks. Smith and Todd (2005) indicate that this should improve the accuracy of the matching procedure. We take the closest five control financial institutions for each treated financial institution. Tables X and Y in the Online Appendix show that our results are robust to resting the sample to the three nearest neighbors, or, oppositely, to extend it to the ten nearest ones.

Table III illustrates the impact of the matching procedure. For each policy reform, this panel shows summary statistics for the pre-treatment period for treated banks, the full sample of non-treated banks and the banks in the control group after the matching procedure. It also reports statistics on the reduction of the differences between the treated banks and the banks in the control group. The summary statistics indicate that full control group is significantly different compared with the treated group in several dimensions for the two policy experiments. For example, treated banks are on average larger.

We measure the success of the matching procedure through three indicators. First, the \textit{Diff} column is the difference in means for the treated banks versus the matched control banks. These differences are no longer significant for most variables after the propensity score matching. Second, the \textit{Bias} columns show the percentage difference of the sample means in the treated and control sub-samples as a percentage of the square root of the average of the sample variances in the treated and control groups (Rosenbaum and Rubin, 1985). We observe a strong decrease in the standardized percentage bias between the treated banks and, respectively, all banks in the full sample and the banks in the matched control group. Third, Figure 1 to 4 illustrates that there is no significant difference in leverage ratios, loan ratios and risk-weighted leverage ratios in the pre-treatment period of each of the policy reform we consider. More information on the distribution of the matched banks for each policy reform can be found in Table X in the Online Appendix.
3.2.3 Main Model

For each policy reform, we compare the change in leverage ratios and loan ratios of treated banks after the reform to the change in leverage ratios and loan ratios of the control group of matched banks that were not affected by the reform. The baseline setup is the following:

\[ Balancesheet\ Item_{b,t} = \beta Treated_b \times Post_t + \gamma C_{c,t-1} + \mu_b + \mu_t + \epsilon_{b,t} \]  

Where \( Balancesheet\ Item_{b,t} \) is the balance sheet item of bank \( b \) at time \( t \), \( Treated_b \) is a dummy that is equal to 1 for all treated banks and \( Post_t \) is a dummy indicator equal to 1 in the post-treatment period. \( \mu_b \) and \( \mu_t \) stand respectively for bank and year fixed effects. The model also includes a vector \( C_{b,t-1} \) of lagged time varying-country characteristics - GDP per capita, GDP per capita growth rate and the log of the CPI - and a vector \( Y_{b,t-1} \) of lagged time-varying bank characteristics to control for bank ex-ante profitability - return on assets -, and bank size - log of total assets, log of total assets squared. The main coefficient of interest is the coefficient \( \beta \) of the interaction variable. Standard errors are clustered at the bank-level in the paper, and at the country level as a robustness check in the Online Appendix. To control for heterogeneous trends across banks based on their characteristics - such as size or leverage ratios - the main specifications also include Year \( \times \) size quintile fixed effect, and Year \( \times \) leverage ratio quintile fixed effects. Size is measured by bank total assets and quintiles are defined the year before the shock.

Our objective is to investigate to which extent changes in the fiscal cost of leverage affect bank capital structure and, as a consequence, its asset allocation. We, therefore, focus on two types of balance sheet items as dependent variables. The first one concerns the capital structure: the leverage ratio and its components, the total amount of common equity and total assets. We indeed aim at investigating what drives the changes in the capital structure and whether the reforms had an effect on bank total size. We would hence be able to identify whether an increase in lending comes along an increase in all bank activities, or not. The
second balance sheet item we are interested in is the loans to assets ratio.

We investigate the heterogeneity of the effects of the policy reforms for two reasons. First, regulators might be interested in whether different types of banks react similarly to changes in the fiscal cost of leverage. For example, if only high capitalized banks react to the policy change, then taxing leverage would be less appealing compared with a situation in which it also impacts banks that ex-ante have a low capital buffer. Second, the heterogeneity of the effect will help us disentangle the mechanism that is driving our results. If low-capitalized banks react more to an ACE, for example, then the effect is more likely to be driven by a change in capital constraints than by a decrease in the cost of capital, as the cost of capital is likely to decrease less for banks that ex-ante hold less equity in their balance sheet.

We therefore test the following model:

\[ \text{Balancesheet Item}_{b,t} = \beta_1 \text{Treated}_b \times \text{Post}_t + \beta_2 \text{Treated}_b \times \text{Post}_t \times \text{EquityRatio}_{b,ex ante} + \lambda Y_{b,t-1} + \gamma C_{c,t-1} + \mu_b + \mu_t + \epsilon_{b,t} \]  

(20)

where \( \text{EquityRatio}_{b,ex ante} \) indicates the bank leverage ratio in the pre-treatment period. The sign of the coefficient \( \beta_2 \) - if negative- would indicate that the effect is larger for banks that are ex-ante less capitalized.

3.2.4 Results

The Fiscal Cost of Leverage and Asset Allocation

We next test the prediction of the model that following an increase in the fiscal cost of leverage, banks shift the composition of their assets towards loans. We also find potentially large, persistent and robust effects.

First, Figure 3 illustrates the dynamics of the effect in the case of the Belgian ACE. Columns (1) to (5) in panel A of Table ?? indicate that the 0.7 pp increase in the leverage ratio converts in a 5% increase in the loans to assets ratio on average following the implementation of the ACE, or 5 pp. This is potentially a large effect, given that the total assets of Belgian banks amount to approximately 60 billion.
euros in 2005. If banks allocate an additional 5 pp of their assets to lending, this would lead to an injection of 3 billion euros in the Belgian economy, or 0.8% of the Belgian GDP in 2005. In addition, if the effect comes mostly from a reallocation of credit to small firms that are constrained ex-ante, the effect on lending to these firms might even be magnified. Consistent with banks shifting the composition of their balance sheet away from assets with low regulatory risk weights, the security to asset ratio decreases.

The increase in the fiscal cost of leverage in the context of the European Liability Tax is also followed by a change in bank asset allocation. The upper part of Figure 6 and columns (1) to (5) in Panel B of Table ?? shows that the increase in the fiscal cost of leverage leads to a 1 pp increase in bank leverage ratios.

Second, consistent with the model predictions, column (2) in Table ?? shows that the effect of a change in the fiscal cost of leverage - either through an ACE or a Liability Tax - is significantly larger for banks that are ex-ante less capitalized and, therefore, more likely to be constrained by the capital requirements.

Finally, the lower parts of Figures 3 and 6, as well as columns (6) to (10) in Table ??, indicate that banks indeed shift their composition of assets away from assets with lower risk weights, i.e. securities.

\[ \text{INSERT FIGURE 3} \]
\[ \text{INSERT FIGURE 6} \]

*The Fiscal Cost of Leverage and Bank Leverage*

We find that a 1 pp increase in the fiscal cost of leverage leads to a decrease in leverage ratios that ranges from 10% to 30%. This is a potentially large effect, given that, for instance, the transition from Basel II to Basel III is supposed to raise minimum capital requirements from 4.5% to 6% over the course of six years. We also find that the effect is mostly driven by an increase in the level of equity for the ACE and a decrease in total assets for the Liability Tax, is larger for banks with ex-ante low level of equity and is higher when bank funding costs are low.

First, Belgian banks increased their leverage ratios - from 6.8% on average ex-ante - by 0.7 percentage point, or 11%, following the implementation of the ACE.
The upper part of Figure 1 first illustrates the dynamics of the effect. While the figure clearly shows that both the treated and the control groups have a similar trend in their leverage ratio during the pre-treatment period, the Belgian banks have leverage ratios more than 10% higher after the 1 pp increase in the fiscal cost of leverage following the implementation of the ACE. Column (1) to (5) in Panel A of Table IX show the corresponding regression coefficient in specifications that we progressively saturate with fixed effects. The result is confirmed. Our results are in line with Schepens (2016), but with a relatively smaller magnitude because of the larger set of fixed effects in our specification.\footnote{We indeed includes year fixed effects - instead of a Post dummy - as well as Year \times Size and Year \times Leverage ratio fixed effect.}

The increase in the fiscal cost of leverage in the context of the European Liability Tax has an effect of a larger magnitude. The upper part of Figure 5 and columns (1) to (5) in Panel B of Table IX shows that the average 8 bps increase in the fiscal cost of leverage leads to a 5% increase in bank leverage ratios or 0.5 pp. The low interest rate environment might amplify the effect of an increase in the taxation of leverage.

Second, consistent with the model predictions, columns (6) and (7) in Table IX and the middle and lower parts of Figures 1 and 5 indicate that the increase in bank leverage ratio following an increase in the fiscal cost of leverage mostly results from an increase in the level of equity in the case of the ACE and a decrease in total assets in the case of the Liability Tax. Columns (6) and (7) decompose the leverage ratio into its two components: the level of equity and bank assets. In the Belgian ACE, the increase in the fiscal cost of leverage leads to an increase in the level of equity of approximately 12% without any increase in the bank total assets. This result suggests that banks did not react to the decrease in the total cost of capital following the Belgian ACE by expanding their assets. In the context of the Liability Tax, the assets decreased by 2.7%, while the amount of equity remained relatively stable.

Third, column (2) in Table IX shows that the effect of a change in the fiscal cost of leverage - either through an ACE or a Liability Tax - is larger for banks that are ex-ante less capitalized and, therefore, more likely to be constrained by
the capital requirements. We include interaction terms between the Treated and Post dummy and the pre-treatment leverage ratios. The results indicate that the impact of the policy change on the bank leverage ratio is significantly higher for banks with lower leverage ratios.

Finally, Figures 1 and 5 indicate that the effect is relatively persistent. Our results are also robust to various changes in our main specification. Table A1 to A5 in the Online Appendix investigate the effect of progressively including fixed effects, clustering at the country rather than at the bank level and building the control group of banks with the three or ten closest banks obtained through the matching procedure.

3.3 The Effects on Lending

3.3.1 Loan-Level Data

Sample Construction

Our principal data source is the German credit register compiled by the Deutsche Bundesbank.

The Bundesbank collects quarterly information on all outstanding loans that exceed €1.5 million at issuance from both domestic and foreign banks which are under supervision in Germany. For each quarter and bank-firm exposure, the German credit register provides information on both the lenders’ and the borrowers’ identities and on the amount of credit that is outstanding.\footnote{The register does not contain immediate information on the interest rate paid or on the maturity of the outstanding loans.}

We build our sample by selecting German firms that borrowed at least once from one foreign bank over the 1994-2013 period. We then construct a balanced quarterly panel of all the bank exposures of these firms. For each bank-firm pair,
we back-fill all quarters for which the pair is not in the credit register with a zero exposure. Hence, if bank \( b \) lends to firm \( f \) and is repaid within a year, the \( bf \) pair will be in our data every quarter during the entire sample period, even though the bank-firm exposure will be equal to zero most of the time.\(^{16}\)

One concern with this loan-level data is that, by construction, our findings could be biased upward. Indeed, we mechanically set unreported exposures that are initially below €1.5 million at zero, while exposures that start above €1.5 million are always reported, even if they subsequently drop below this threshold through repayment. We might, therefore, overestimate the increase in any bank-firm exposure that jumps above the 1.5 million hurdle. However, by construction, the selection of our sample mitigates this concern. First, we select firms that borrow from foreign banks. These firms are larger and more likely to borrow in large volumes. Second, among these firms, our favorite specification restricts the sample to those that borrow concurrently from multiple banks, and again especially large firms do so, and to bank-firm exposures that exceed €1.5 million at issuance, to investigate the effect at the intensive margin.

Summary Statistics

Foreign lending is active in Germany over our sample period. Table X in the online appendix shows summary statistics on the lending activities of banks headquartered outside Germany. Over the 1994-2013 period, 257 banks are actively lending in Germany to more than 53,000 firms. The exposure of foreign banks to German firms has significantly increased, at an average rate of 3.5%. Finally, lending by foreign banks is more volatile than lending by German banks. The standard deviation of the yearly growth in the loan exposure to German firms is twice as large for foreign banks than for German banks.

\[\text{INSERT TABLE IV}\]

\(^{16}\)When two banks merge, we artificially create a third bank for the time period after the merger.
3.3.2 Identification Strategy

We investigate the effects of an increase in the fiscal cost of leverage focusing on foreign lending by affected firms on the German credit market for the following reasons. First, focusing our analysis on foreign lending in Germany allows us to exploit a treatment that is exogenous both to control bank characteristics - as the treatment is only driven by the home country of the foreign banks - and to the German economic situation. The state of the economy in Germany is unlikely to have affected the adoption of the ACE in Belgium, which was mostly driven by the repeal of a Belgian fiscal advantage by the European Union. Second, Germany has an active bank credit market with a large, but reasonable presence of foreign banks from multiple countries. The significant number of banks active in Germany that are affected by the shock we exploit allows us to ensure that the effect is not driven only by some bank specific trend. Third, the strength of the German economy implies that banks can easily expand lending, and its stability limits the possible effects of confounding factors on our results. Finally, because we compare lending by treated banks versus non-treated German and foreign banks with bank fixed effects we can control for demand and sure that the effect we observe is indeed, a credit supply shock.

The benchmark model is the following:

$$\log L_{b,f,t} = \alpha Treated_{b,f} \times Post + \beta X_{f,t} + \gamma Y_{b,t} + \mu_b + \mu_f + \mu_t + \epsilon_{b,f,t}$$ (21)

where $\log L_{b,f,t}$ is the logarithm of lending exposure of bank $b$ to firm $f$ in quarter $t$, $Treated_{b,f}$ is a dummy indicating whether the government has implemented a tax reform on bank leverage, $Post$ is a dummy that equals one after the reform is implemented, $X_f$ is a vector of firm specific controls to capture changes in lending policies that are related to firm characteristics rather than regulation and $Y_b$ is a vector of bank controls. Error terms are clustered at the bank and firm levels.

For the Liability Tax, we use this panel model with bank, firm and quarter fixed effects because the implementation is staggered across years. However, for the Belgian ACE, because we compare a pre- to a post-period in a difference-in-
differences setting, we estimate the following model:

\[ \text{CreditGrowth}_{b,f} = \alpha \text{Treated}_{b,f} + \beta \text{X}_f + \gamma \text{Y}_b + \epsilon_{b,f} \]  

(22)

where \( \text{CreditGrowth}_{b,f} \) is the growth rate in lending exposure of bank \( b \) to firm \( f \) between the pre- and the post-shock period using Davis and Haltiwanger (1992)’s growth measure, \( \text{Treated}_{b,f} \) is a dummy indicating whether the bank has been treated by a tax reform that affects leverage, \( \text{X}_f \) is a vector of firm specific controls in the pre period to capture changes in lending policies that are related to firm characteristics rather than regulation (size, profitability etc.) or firm fixed effects depending on the specification and \( \text{Y}_b \) is a vector of bank controls in the pre-period. Error terms are clustered at the bank and firm levels.

In both models, bank controls include the logarithm of total assets, the leverage ratio, and the return on assets (ROA) at date \( t - 1 \), and bank type fixed effects.

Firm controls include information from financial reports - total sales, total assets, leverage, debt structure and returns on assets -, the number of banks the firm is borrowing from, the total volume of bank debt and 100 industry fixed effects. We also control for the distance of the firms to the border or the country where the fiscal reform has taken place. We hence control for demand for credit by firms that are more likely to trade with the affected country and subsequently experience growth in sales or profitability.

In order to comprehensively account for the firm demand for credit, we saturate some specifications with firm \( \times \) quarter fixed effects in Model (21), and firm fixed effects in Model (22). We, therefore, restrict our sample to multi-bank firms, i.e., firms borrowing from at least two different banks in the period before the shock. This identification relies on the estimation of the evolution of lending to firm \( f \) by bank \( b \) that is treated by the fiscal reform compared to lending to the same firm \( f \) by bank \( b' \) that is not exposed to the shock. This approach allows us to control for changes in credit that are driven by changes in firm-specific demand.

Our empirical analysis unfolds in four steps. First, we look at the effects of each event on all bank-firm exposures. In a second step, we restrict our analysis to firms that borrow actively in the pre-period, and, for these firms, we keep only
all bank-firm exposures that are strictly larger than zero in the pre-period. With this specification, we estimate how a bank that is treated by a shock in regulation changes its lending to its current borrowers compared to the other competing banks that are also lending to the same borrowers, but that are not treated by the same shock. We also control for relationship characteristics, such as the length of the relationship and the size of the relationship. The length of the relationship is the number of quarters the exposure of bank $b$ to firm $f$ has been strictly positive from 1994 onwards (i.e., the beginning of our sample) to date $t - 1$. The size of the bank-firm relationship is the total amount that has been lent by bank $b$ to firm $f$ from 1994 to date $t - 1$. Both variables are in logarithm. In a third step, we investigate the effect of each event at the extensive margin by studying new loans. The model we estimate is the same as in (21) and (22) except that the dependent variable is a dummy variable that indicates whether a new loan is granted to a firm with an ex-ante zero exposure to the credit granting bank.

### 3.3.3 Results

We find that banks that are affected by an increase in the fiscal cost of leverage subsequently increase lending to German firms.

Figure 7 first plots changes in loan exposure of Belgian banks versus other banks lending in Germany over the 2003-2007 period. We focus only on exposures that are strictly positive in 2003 as these exposures are reported until the loan is fully repaid whatever the amount. There is therefore no concern of censoring related to the 1.5m threshold at the intensive margins. We see that while Belgian banks have largely extended loans after the shocks as compared to control banks.

Table VI confirms the result. Column (1) shows the coefficient of the Treated dummy in regression (22): lending by Belgian firms increased by 20 percentage points more after the implementation of the allowance for corporate equity. The effect is robust to controlling for demand with firm fixed effects (column (2)), and to restricting the sample to lending by foreign banks only (columns (3) and (4)). Finally, the effect is strong both at the intensive and extensive margins.

[INSERT FIGURE 7]
3.4 Firm-Level Analysis

We here use firm level data to investigate whether banks have extended lending mostly to firms that are more likely to be credit rationed and have higher risk weights, as the model predicts.

3.4.1 Firm-level Data

Finally, we exploit data on borrowing firms from the Bundesbank’s Corporate Balance Sheets database (Ustan). Ustan collects information on firms every year in the context of the refinancing policies of the Central Bank. The Bundesbank uses the information to assess whether a loan can be eligible as collateral. The sample of firms with information from Ustan includes all the firms for which an exact match between the credit register and Ustan was possible based on the firm name, location and industry. We extract from Ustan the firm industry classification, total assets, total sales, leverage, employment and return on assets. Firms are classified in close to 100 industries. We also use firm zip codes to measure the borrower’s distance to the treated country and hence control for demand effects.

3.4.2 Identification Strategy

We first restrict the sample to all the firms that are borrowing from affected banks both in the pre and in the post period. We then investigate whether the firms that start borrowing from treated banks in the post period are ex-ante significantly different from the firms the treated banks were already lending to.

We hence test the following model, where FirmCharacteristics is the firm total bank debt, leverage, assets and sales:

\[
\log(FirmCharacteristics_{f,before}) = \alpha_{\text{New Borrower}} + X_f + \epsilon_f \quad (23)
\]
Second, we investigate on the total sample how the increase in lending by affected banks impact borrowers’ characteristics. We look at the effect on debt by aggregating lending by all engaged banks at the firm-level and hence observe whether treated banks are substituting or not to other banks when they increase lending. We also look at the effect on firm leverage, total assets and employment. Finally, we explore the effect on the total interest paid by the firm, controlling for the debt structure. We hence get a proxy for the cost of credit and analyze whether these reforms on the fiscal cost of leverage have an effect on the level of interest rates.

We, therefore, test the following model, where our variable of interest $Treated$ indicates firms that are borrowing from at least one treated bank:

$$\Delta \log \text{FirmCharacteristics}_f = \alpha Treated_f + X_f + \epsilon_f$$

where $X_f$ is a vector of firm controls. Error terms are clustered at the firm-level.

### 3.4.3 Results

We estimate the change in the loan portfolio of banks that are affected by the Belgian ACE. We do not focus on the Liability Tax as the staggered introduction across a sample of banks does not allow to clearly identify treated from non treated firms.

We start by examining the characteristics of firms banks extend lending to when they face an increase in the fiscal cost of leverage. In the first four columns of Table VII the sample consists in the firm Belgian banks are borrowing to in the post period. The dummy $NewBorrower$ identifies among these firms those that are new borrowers. We find that new borrowers have ex-ante lower debt (column (1)), but that they are also smaller (column (2)). These results suggest that Belgian banks are lending to firms with ex-ante a lower access to credit and possibly high risk weights.

INSERT TABLE VII

We then turn to investigating how the increase in lending by Belgian banks
affected the characteristics of these German firms in columns (5) to (9). We control for firm characteristics ex-ante. Columns (5) to (7) indicate a growth in bank debt, leverage and assets that is respectively 20 pp, 6 pp and 6 pp higher for firms that are borrowing from Belgian banks ex-ante. This result suggests that these firms are ex-ante credit constrained and then benefit from an increase in supply by affected banks.

4 The Liability Tax (2009-2012)

4.1 Background

The second set of reforms we consider is the Liability Tax that has been implemented across seven European countries over the 2009-2012 period.

The IMF started promoting the implementation of a Liability Tax for banks in the aftermath of the financial crisis. The objective was to make banks pay for the fiscal cost of any future government support to the sector and to internalize banks’ contributions to systemic risk \(\text{[Buch et al., 2016, Devereux et al., 2017]}\). Following the IMF recommendation, in the absence of any multi-country agreement, fourteen EU countries adopted some bank levies unilaterally. Among them, eleven implemented a tax on bank liabilities. Our sample - composed of the fifteen largest European banking economies - includes the following seven countries that adopted a Liability Tax: Austria, Belgium, Germany, the Netherlands, Portugal, Sweden and the UK.

The Liability Tax has the following unique properties that make a nice set-up to address our research question. First, the Liability Tax only concerns banks. We can, therefore, observe the effect on bank activities in a set-up where the demand for loans is not directly affected.

Second, the Liability Tax was implemented in seven countries in our sample of fifteen countries, and the implementation was staggered between September 2009 in Sweden to 2012. We can therefore implement a panel analysis to investigate the effect of the reform. Because France adopted a bank levy with a totally different
tax base - the minimum amount of capital necessary to comply with the regulatory requirements - we include France in the control group.

Third, in terms of magnitude, the average tax rate of 8 bps significantly reduced the tax advantage of debt in an environment with low interest rates.\textsuperscript{17} Consistent with its significant impact, the UK bank Liability Tax raised on average GBP 2.6 billion each year from 2011 to 2016, the German one €800 million and the Austrian bank Liability Tax raised €645 million each year.

Table \ref{table:liability_tax} displays the parameters of the Liability Tax across countries. The design of the Liability Tax varies along three dimensions: The base, the rate, and the use of revenues (Devereux et al., 2017). In most countries, the base is the liabilities net of equity and customer deposits of financial institutions.\textsuperscript{18} In some countries, however, not all banks are affected. In Austria and in Germany, for example, only banks with respectively more than 1 billion and 300 million euros of liabilities are affected. The rates also vary across banks and countries, from 1 basis point (bp) in Germany for banks with less than 1 billion euros in liabilities to 8.5 bps for Austrian banks with more than 20 billion euros of liabilities. Finally, while in Germany and Sweden, the revenues go to a special reserve fund to support banks in financial distress, in the UK, revenues go to the budget.\textsuperscript{19} See the Online Appendix for more details about the scope and parameters of each tax we consider.

\begin{table}[h]
\centering
\caption{Parameters of the Liability Tax across countries.}
\begin{tabular}{|c|c|c|}
\hline
Country & Base & Rate \\
\hline
UK & GBP liabilities net of equity & 8 bps \\
Germany & EUR liabilities net of equity & 1 bp for banks with less than 1 billion EUR, 8.5 bp for banks with more than 20 billion EUR \\
Austria & EUR liabilities net of equity & 8.5 bp \\
\hline
\end{tabular}
\end{table}

5 Conclusion

Our paper contributes to the debate on bank capital regulation by considering a complementary tool to monitor bank leverage: taxing bank leverage. We investigate the effects of taxing bank leverage on bank leverage and credit supply by exploiting the staggered implementation of tax reforms in Europe from 2005 to 2010. The positive impact of an increase in the fiscal cost of leverage resulting

\textsuperscript{17} After 2010, banks funding rates are around 1% in the Euro Zone.

\textsuperscript{18} While most levies treat short-term and long-term liabilities symmetrically, the Netherlands and the UK apply a reduced rate to liabilities with a maturity exceeding one year.

\textsuperscript{19} The UK government was concerned that the fund will create some moral hazard issues.
from these reforms on both bank leverage ratios and lending suggest that bank funding risk can be controlled through taxes, without negatively affecting bank lending. Our results also suggest that banks are not increasing risk taking.

We consider two types of policy reforms that affect the fiscal cost of leverage. Both trigger future research questions. The first one, the ACE, is a fiscal deduction. Does the resulting benefit of an ACE on financial stability and the real economy compensate for the fiscal cost? In an environment with low interest, can the deduction of a notional interest from taxes still affect bank capital structure? The second one, the Liability Tax, is a tax on bank liabilities. In an open-economy, where domestic banks compete internationally, can a tax on bank liabilities affect the competitiveness of banks and then their profitability?

The limits of regulating bank leverage with capital requirements are well documented. Higher capital requirements may lead to a decrease in bank lending [Aiyar et al., 2014; Fraisse et al., 2016; Jiménez et al., 2017] - with adverse consequences for firms, employment, and households, - regulatory arbitrage [Kashyap et al., 2010; Efing, 2018; Greenwood et al., 2017], and the growth of the shadow banking sector. Overall, our paper shows that regulation through taxes might complement a regulation through bank capital requirements.
References


A Figures
Figure 1: Subsidizing Equity and Bank Capital Structure: Evolution of the Equity to Assets Ratio, Equity and Total Assets in Belgian Banks following the Belgian ACE

This figure shows the evolution of the equity to assets ratio, the amount of equity and the total assets for Belgian banks relatively to a control group of European banks obtained through propensity score matching over the 2002-2010 period. The figure illustrates the results from regression (1) where Treated $\times$ Post is replaced with a set of dummies indicating year relative to the introduction of the ACE. The dependent variable is, respectively, equity / total assets, total equity and total assets, in log. The line connects dots that represent point estimates and the bars indicate 90% confidence bounds based on standard errors clustered at the bank levels. The vertical line corresponds to the year the ACE was approved: 2005. Consistent with the model predictions, both the leverage ratio and the equity of affected banks increase following the implementation of the ACE.
Figure 2: Subsidizing Equity and Bank Asset Allocation: Evolution of the Loans to Assets ratio of Belgian Banks following the Belgian ACE (2005)

This figure shows the evolution of the loans to assets ratio for Belgian banks relatively to a control group of European banks obtained through propensity score matching over the 2002-2010 period. The figure illustrates the results from regression (1) where Treated $\times$ Post is replaced with a set of dummies indicating year relative to the introduction of the ACE. The dependent variable is loans / total assets, in log. The line connects dots that represent point estimates and the bars indicate 90% confidence bounds based on standard errors clustered at the bank levels. The red vertical line corresponds to the year the ACE was approved: 2005. Consistent with the model predictions, affected banks shift their assets towards loans following the implementation of the ACE.
Figure 3: Subsidizing Equity and Bank Asset Allocation: Evolution of the Loans to Assets ratio of Belgian Banks following the Belgian ACE (2005)

This figure shows the evolution of the loans to assets ratio for Belgian banks relatively to a control group of European banks obtained through propensity score matching over the 2002-2010 period. The figure illustrates the results from regression (1) where Treated × Post is replaced with a set of dummies indicating year relative to the introduction of the ACE. The dependent variable is loans / total assets, in log. The line connects dots that represent point estimates and the bars indicate 90% confidence bounds based on standard errors clustered at the bank levels. The vertical line corresponds to the year the ACE was approved: 2005. Consistent with the model predictions, affected banks shift their assets towards loans following the implementation of the ACE.
Figure 4: Subsidizing Equity and Bank Lending: Evidence from Lending by Belgian Banks to German Firms (Intensive Margin)

This figure splits the sample of Belgian banks into two groups based on their equity to assets ratio in 2005. The figure shows the average equity to assets ratio and loan to assets ratios across these two groups of banks are in comparison to control bank of banks obtained through propensity matching.
Figure 5: Taxing Bank Debt and Bank Capital Structure: Evolution of the Equity to Assets Ratio, Amount of Equity and Total Assets of European Banks after the Implementation of a Liability Tax (2010 - 2012)

This figure shows the evolution of leverage ratios, amount of equity and total assets for banks affected by the implementation of the levy relatively to other European banks over the 2008-2012 period. The figure illustrates the results from regression (1) where Treated $\times$ Post is replaced with a set of dummies indicating year relative to the introduction of the levy. The dependent variable is, respectively, equity / total assets, total equity and total assets, in log. The control group is obtained using propensity score matching. The line connects dots that represent point estimates and the bars indicate 90% confidence bounds based on standard errors clustered at the bank levels. The vertical line corresponds to the year the levy is implemented in each country that is affected (2010, 2011 or 2012).
Figure 6: The Effect of a Liability Tax on Bank Asset Allocation: Evolution of the Loan to Assets and Securities to Assets ratios of European Banks after the Implementation of a Liability Tax

This figure shows the evolution of the loans to assets ratios for banks affected by the implementation of the levy relatively to other Eurozone banks over the 2008-2012 period. The figure illustrates the results from regression (1) where Treated $\times$ Post is replaced with a set of dummies indicating year relative to the introduction of the levy. The dependent variable is, respectively, equity / total asset, total equity and total assets, in log. The control group is obtained using propensity score matching. The line connects dots that represent point estimates and the bars indicate 90% confidence bounds based on standard errors clustered at the bank levels. The vertical line corresponds to the year the levy is implemented in each country that is affected (2010, 2011 or 2012).
Figure 7: Taxing Bank Debt and Bank Behaviour: Evidence from the Liability Tax in Slovakia

This figure shows the changes in the equity to asset ratios and the loans to asset ratios of the Slovakian subsidiaries of the 10 European banks with subsidiaries in Slovakia as opposed to their subsidiaries in the same geographical area.
## B Tables

### Table I. Model Testable Predictions

<table>
<thead>
<tr>
<th></th>
<th>Increase in Capital Requirements</th>
<th>Allowance for Corporate Equity</th>
<th>Liability Tax</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Asset Allocation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loans to Assets Ratio</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>RWA/TA</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Total Lending</td>
<td>-</td>
<td>+</td>
<td>ND</td>
</tr>
<tr>
<td><strong>Capital structure</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equity to Assets ratio</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>CT1 Ratio (Equity/RWA)</td>
<td>+</td>
<td>Constant</td>
<td>Constant</td>
</tr>
<tr>
<td><strong>Bank Risk</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Funding Risk</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Total Risk</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

This table reports the empirical predictions of the portfolio allocation model developed in Section 2.
Table II. Description of the Fiscal Reforms

<table>
<thead>
<tr>
<th>Type</th>
<th>Country</th>
<th>Base</th>
<th>Rate</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsidy</td>
<td>Belgium</td>
<td>Book value of equity: statutory equity and retained earnings</td>
<td>Average 10-year government bond rate</td>
<td>2005</td>
</tr>
<tr>
<td>1. Allowance for Corporate Equity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tax</td>
<td>Austria</td>
<td>Total liabilities net of equity and insured deposits</td>
<td>From 5.5 to 8.5 bps</td>
<td>2011</td>
</tr>
<tr>
<td>Tax</td>
<td>Belgium</td>
<td>-</td>
<td>3.5 bps</td>
<td>2012</td>
</tr>
<tr>
<td>Tax</td>
<td>Germany</td>
<td>-</td>
<td>From 2 to 6 bps</td>
<td>2011</td>
</tr>
<tr>
<td>Tax</td>
<td>Sweden</td>
<td>-</td>
<td>1.8 bps in 2009 and 2010, 3.6 bps after</td>
<td>2010</td>
</tr>
<tr>
<td>Tax</td>
<td>Netherlands</td>
<td>-</td>
<td>4.4 bps</td>
<td>2012</td>
</tr>
<tr>
<td>Tax</td>
<td>United Kingdom</td>
<td>-</td>
<td>Increased from 7.5 bps in 2011 to 13 bps in 2013</td>
<td>2011</td>
</tr>
<tr>
<td>Tax</td>
<td>Portugal</td>
<td>Total liabilities net of equity and subordinated debt</td>
<td>5 bps</td>
<td>2011</td>
</tr>
<tr>
<td>2. Liability Tax (First Experiment)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tax</td>
<td>Slovakia</td>
<td>Total liabilities net of equity and insured deposits</td>
<td>40 bps</td>
<td>2011</td>
</tr>
</tbody>
</table>

This table reports the parameters of the fiscal reforms that have affected the fiscal cost of leverage of European banks from 2005 to 2012. The legal status and other details about each reform are available in the Online Appendix. Note that the threshold for the liability tax in UK is £20 billion in 2011, i.e. €23 billion in 2011. Sources: KPMG, PWC, Devereux et al. (2017).
### Table III. Bank Level Data: Summary Statistics and Propensity Score Matching Diagnostics

<table>
<thead>
<tr>
<th>Treatment Group</th>
<th>Mean</th>
<th>p50</th>
<th>p10</th>
<th>p90</th>
<th>Mean</th>
<th>Diff</th>
<th>Bias</th>
<th>p50</th>
<th>p10</th>
<th>p90</th>
<th>Mean</th>
<th>Diff</th>
<th>Bias</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Assets</td>
<td>60,575</td>
<td>2,967</td>
<td>371</td>
<td>287,676</td>
<td>18,255</td>
<td>-42,319**</td>
<td>-29</td>
<td>1,292</td>
<td>230</td>
<td>13,493</td>
<td>49,108</td>
<td>-8,523</td>
<td>-4</td>
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<td>5.2</td>
<td>2.7</td>
<td>10.9</td>
<td>7.7</td>
<td>0.99</td>
<td>15.8</td>
<td>6.0</td>
<td>3.1</td>
<td>14.1</td>
<td>6.8</td>
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<td>-2.5</td>
<td>-18.5</td>
<td>25.8</td>
<td>1.6</td>
<td>1.6</td>
<td>0.9</td>
<td>2.3</td>
<td>-11.2</td>
<td>10.8</td>
<td>-0.0</td>
<td>-1.5</td>
<td>-8.7</td>
</tr>
<tr>
<td>Loan Ratio</td>
<td>44.4</td>
<td>46.4</td>
<td>13.4</td>
<td>77.1</td>
<td>61.3</td>
<td>16.9***</td>
<td>72</td>
<td>64.1</td>
<td>25.5</td>
<td>89.2</td>
<td>43.4</td>
<td>-0.55</td>
<td>-2.3</td>
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<tr>
<td>ROA</td>
<td>1.1</td>
<td>0.6</td>
<td>0.2</td>
<td>2.0</td>
<td>0.7</td>
<td>0.46**</td>
<td>-28.3</td>
<td>0.3</td>
<td>0.1</td>
<td>1.5</td>
<td>0.6</td>
<td>-0.36</td>
<td>-22</td>
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<tr>
<td>NII Ratio</td>
<td>30.6</td>
<td>27.5</td>
<td>7.1</td>
<td>64.0</td>
<td>31.0</td>
<td>0.39</td>
<td>1.9</td>
<td>25.7</td>
<td>12.5</td>
<td>58.3</td>
<td>40.1</td>
<td>8.4</td>
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<td>Z-score</td>
<td>86.1</td>
<td>24.2</td>
<td>12.3</td>
<td>115.4</td>
<td>128.4</td>
<td>42.3</td>
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<td>GDPPC Level</td>
<td>32,500</td>
<td>32,500</td>
<td>32,500</td>
<td>32,500</td>
<td>37,341</td>
<td>4,840*</td>
<td>51.3</td>
<td>29,800</td>
<td>28,000</td>
<td>52,600</td>
<td>39,149</td>
<td>6,256*</td>
<td>55</td>
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<tr>
<td>Growth</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>0.03</td>
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<td>34.0</td>
<td>34.0</td>
<td>34.0</td>
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<td>-40</td>
<td>35.0</td>
<td>21.3</td>
<td>38.9</td>
<td>32.6</td>
<td>-1.4</td>
<td>-28</td>
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<td>Effective</td>
<td>22.5</td>
<td>23.0</td>
<td>0.0</td>
<td>45.5</td>
<td>36.3</td>
<td>13.8***</td>
<td>62</td>
<td>30.4</td>
<td>0.0</td>
<td>69.2</td>
<td>34.9</td>
<td>12.4*</td>
<td>57</td>
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<td>Observations</td>
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</table>

**Panel A: The Belgian ACE (2006)**

<table>
<thead>
<tr>
<th>Treatment Group</th>
<th>Mean</th>
<th>p50</th>
<th>p10</th>
<th>p90</th>
<th>Mean</th>
<th>Diff</th>
<th>Bias</th>
<th>p50</th>
<th>p10</th>
<th>p90</th>
<th>Mean</th>
<th>Diff</th>
<th>Bias</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Assets</td>
<td>43,150</td>
<td>1,940</td>
<td>317</td>
<td>18,307</td>
<td>18,255</td>
<td>-10,982</td>
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<td>320</td>
<td>260</td>
<td>42,640</td>
<td>49,108</td>
<td>-510</td>
<td>-0.2</td>
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<tr>
<td>Leverage ratio</td>
<td>7.7</td>
<td>6.0</td>
<td>4.1</td>
<td>12.5</td>
<td>9.5</td>
<td>1.76***</td>
<td>26</td>
<td>8.1</td>
<td>5.0</td>
<td>4.5</td>
<td>8.8</td>
<td>1.33**</td>
<td>17.5</td>
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<td>Growth</td>
<td>5.5</td>
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<td>18.7</td>
<td>4.7</td>
<td>0.73</td>
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<td>1.2</td>
<td>-10.3</td>
<td>25.0</td>
<td>4.9</td>
<td>-0.5</td>
<td>-3.3</td>
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<td>Loan Ratio</td>
<td>55.5</td>
<td>57.9</td>
<td>28.8</td>
<td>78.1</td>
<td>64.4</td>
<td>16.9***</td>
<td>72</td>
<td>74.4</td>
<td>19.6</td>
<td>87.6</td>
<td>60.5</td>
<td>4.9***</td>
<td>21.8</td>
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<tr>
<td>ROA</td>
<td>0.3</td>
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<td>0.9</td>
<td>0.5</td>
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<td>0.0</td>
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<td>3.5***</td>
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<td>13.3</td>
<td>70.5</td>
<td>35.1</td>
<td>1.9***</td>
<td>26</td>
</tr>
<tr>
<td>ERWA</td>
<td>12.1</td>
<td>10.8</td>
<td>8.3</td>
<td>17.3</td>
<td>14.2</td>
<td>2.1***</td>
<td>33.7</td>
<td>13.1</td>
<td>8.1</td>
<td>19.9</td>
<td>13.9</td>
<td>1.9***</td>
<td>26</td>
</tr>
<tr>
<td>Impaired Loan Ratio</td>
<td>33.5</td>
<td>17.0</td>
<td>3.0</td>
<td>82.0</td>
<td>29.1</td>
<td>-4.6</td>
<td>-11.5</td>
<td>16.7</td>
<td>1.8</td>
<td>78.6</td>
<td>40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GDPPC Level</td>
<td>32,909</td>
<td>30,800</td>
<td>30,800</td>
<td>37,400</td>
<td>48,060</td>
<td>15,569***</td>
<td>51.3</td>
<td>54,900</td>
<td>23,300</td>
<td>66,600</td>
<td>44,084</td>
<td>11,999***</td>
<td>88</td>
</tr>
<tr>
<td>Growth</td>
<td>-5.0</td>
<td>-5.3</td>
<td>-5.3</td>
<td>-4.0</td>
<td>-4.3</td>
<td>0.65***</td>
<td>65.4</td>
<td>-4.4</td>
<td>-6.0</td>
<td>-5.0</td>
<td>0.03</td>
<td>3</td>
<td>-5.4</td>
</tr>
<tr>
<td>Tax Rate</td>
<td>28.7</td>
<td>30.2</td>
<td>25.0</td>
<td>30.2</td>
<td>26.7</td>
<td>-2.1***</td>
<td>-61</td>
<td>28.0</td>
<td>21.2</td>
<td>31.4</td>
<td>27.2</td>
<td>-1.5***</td>
<td>-48</td>
</tr>
<tr>
<td>Effective</td>
<td>40.9</td>
<td>40.5</td>
<td>0.0</td>
<td>80.0</td>
<td>24.7</td>
<td>-16***</td>
<td>-64</td>
<td>28.0</td>
<td>21.2</td>
<td>31.4</td>
<td>26.2</td>
<td>-14***</td>
<td>-56</td>
</tr>
<tr>
<td>Observations</td>
<td>843</td>
<td>444</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This table reports summary statistics and matching diagnostics for the pre-treatment period of each policy reforms we consider: 2005 for the Belgian ACE (Panel B) and 2009 for the bank levy (Panel C). The left hand side part of each panel shows summary statistics for the treatment group, the middle part focuses on the full sample of non-treated banks and the right hand part shows information for the non-treated banks that are selected for the control group after the matching procedure. The "Diff" columns of the middle and right hand side parts of the table show the difference in the average of non-treated banks versus treated banks. ***, **, * indicate p values respectively lower than 0.01, 0.05 and 0.1 for a t-test that checks whether the average for the non-treated banks is equal to the average value for the treated banks. The columns "Bias" show the standardized percentage bias between the treated banks and the non-treated banks. The bias is the % difference of the sample means in the treated and non-treated sub-samples as a percentage of the square root of the average of the sample variances in the treated and non-treated groups (Rosenbaum and Rubin, 1985). Total Assets are reported in million euros, all ratios in % and GDP per capital in euros.
Table IV. Loan-level Data: Summary Statistics

### Panel A: The Belgian ACE (2006)

<table>
<thead>
<tr>
<th></th>
<th>Control Group</th>
<th>Treated Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Mean</td>
</tr>
<tr>
<td><strong>Bank-Firm Exposures</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size (in €th.)</td>
<td>27,914</td>
<td>5,361</td>
</tr>
<tr>
<td>% Change</td>
<td>11,714</td>
<td>15.5</td>
</tr>
<tr>
<td>New loans (%)</td>
<td>27,914</td>
<td>6.0</td>
</tr>
<tr>
<td><strong>Bank Characteristics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Assets</td>
<td>1.521</td>
<td>23,930</td>
</tr>
<tr>
<td>Leverage ratio</td>
<td>1.521</td>
<td>5.8</td>
</tr>
<tr>
<td>ROA</td>
<td>1,498</td>
<td>.8</td>
</tr>
<tr>
<td><strong>Firm Characteristics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Debt</td>
<td>3,572</td>
<td>182,157</td>
</tr>
<tr>
<td># Relationship Banks</td>
<td>29,400</td>
<td>1.9</td>
</tr>
<tr>
<td>Assets</td>
<td>3,572</td>
<td>270,752</td>
</tr>
<tr>
<td>Sales</td>
<td>3,572</td>
<td>215,978</td>
</tr>
<tr>
<td>ROA</td>
<td>3,572</td>
<td>.6</td>
</tr>
<tr>
<td>Leverage</td>
<td>3,505</td>
<td>7.5</td>
</tr>
<tr>
<td>Debt Structure</td>
<td>3,572</td>
<td>0.3</td>
</tr>
<tr>
<td>Distance from Belgium</td>
<td>23,147</td>
<td>436</td>
</tr>
</tbody>
</table>

### Panel B: The Liability Tax (2010-2012)

<table>
<thead>
<tr>
<th></th>
<th>Control Group</th>
<th>Treated Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Mean</td>
</tr>
<tr>
<td><strong>Bank-Firm Exposures</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size (in thousand Euros)</td>
<td>1,313</td>
<td>1,552</td>
</tr>
<tr>
<td>Change in exposure, in New loans</td>
<td>603</td>
<td>-0.2</td>
</tr>
<tr>
<td><strong>Bank Characteristics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Assets</td>
<td>19</td>
<td>142,328</td>
</tr>
<tr>
<td>Leverage ratio</td>
<td>40</td>
<td>7.2</td>
</tr>
<tr>
<td>ROA</td>
<td>40</td>
<td>0.3</td>
</tr>
<tr>
<td><strong>Firm Characteristics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Debt</td>
<td>122.0</td>
<td>21,449</td>
</tr>
<tr>
<td># Relationship Banks</td>
<td>4,401</td>
<td>0.3</td>
</tr>
<tr>
<td>Assets</td>
<td>122.0</td>
<td>26,942</td>
</tr>
<tr>
<td>Sales</td>
<td>122.0</td>
<td>35,952</td>
</tr>
<tr>
<td>ROA</td>
<td>122.0</td>
<td>5.0</td>
</tr>
<tr>
<td>Leverage</td>
<td>117.0</td>
<td>12.8</td>
</tr>
<tr>
<td>Debt Structure</td>
<td>122.0</td>
<td>0.1</td>
</tr>
</tbody>
</table>

For each policy reforms, this table reports summary statistics for banks that are affected, control banks and the control group of matched banks. Panel A reports summary statistics in 2005, before the implementation of the ACE in Belgium, and Panel C in 2009, before the introduction of taxes on bank liabilities net of equity.
Table V. Subsidizing Equity, Bank Asset Mix and Risk Taking: Evidence from the Belgian ACE (2003-2007)

<table>
<thead>
<tr>
<th></th>
<th>Equity to Assets Ratio</th>
<th>Loans to Assets Ratio</th>
<th>Risk Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Log</td>
<td>Amount</td>
<td>Log</td>
</tr>
<tr>
<td></td>
<td>(1) Low ETA (2) High ETA (3)</td>
<td>(4) Low ETA (5) High ETA (6)</td>
<td>(7) Low ETA (8)</td>
</tr>
<tr>
<td>Treated × Post</td>
<td>0.112** (0.045)</td>
<td>0.772** (0.379)</td>
<td>-0.031 (0.767)</td>
</tr>
<tr>
<td>Size × Year</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Capital × Year</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Year</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Bank FE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Bank Controls</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Country Controls</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Observations</td>
<td>867</td>
<td>548</td>
<td>314</td>
</tr>
<tr>
<td>R²</td>
<td>0.929</td>
<td>0.770</td>
<td>0.848</td>
</tr>
</tbody>
</table>

This table analyzes the impact of the introduction of the Belgian ACE in 2005 on bank asset mix, capital structure and risk taking in a differences-in-differences setup over the 2003-2007 period. The dependent variable is the equity to asset ratio in columns (1) to (3), the loan to assets ratio in columns (4) to (6), the regulatory ratio in column (7), the ratio of risk weighted assets to total assets in column (8), the Z score in column (9) and the ratio of impaired loans in column (10). The table displays the coefficient of the interaction of the dummy variable Post - equal to one after the introduction of the ACE reform in 2005 - and the dummy Treated that indicates whether the bank is a treated bank. Models are estimated using OLS and include both bank and year fixed effects, time varying bank controls - Return on assets, log of total assets, log of total assets squared - and country controls - GDP per capita and GDP per capita growth rate. All these variables are lagged - and total asset is also lagged twice. The model also includes Year × ex-ante asset quintile fixed effects and Year × ex-ante leverage ratio quintiles in columns (1) to (6). Standard errors are clustered at the bank level.
Table VI. Subsidizing Equity and Credit Supply: Evidence from Lending by Belgian Banks in Germany (2004-2007)

<table>
<thead>
<tr>
<th>Model</th>
<th>All Bank-Firm Exposures</th>
<th>Intensive Margin</th>
<th>Extensive Margin</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All</td>
<td>Foreign</td>
<td>All</td>
</tr>
<tr>
<td></td>
<td>Growth in Loan Exposure, in %</td>
<td>Banks</td>
<td>Growth in Loan Exposure, in %</td>
</tr>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>Treated</td>
<td>21.2***</td>
<td>22.39***</td>
<td>28.53***</td>
</tr>
<tr>
<td></td>
<td>(7.2)</td>
<td>(7.4)</td>
<td>(10.92)</td>
</tr>
</tbody>
</table>

This table shows the effect of the introduction of an ACE in Belgium in 2005q2 on lending by Belgian banks in Germany. We take the introduction of the ACE as an event and collapse all quarterly data 1 year before and 2 years after into a single pre- and post-event period. The dependent variable in columns (1) to (6) is the bank-firm exposures growth rate in % between the pre- and post-event period, in columns (7) and (8) a dummy variable that is equal to one if a new loan is granted to a firm with currently zero exposure to the credit granting bank and is equal to zero otherwise. The initial sample comprises all bank-firm exposures involving firms that borrow from at least two banks headquartered in different countries during the 1994-2013 period. In columns (2) and (4) the sample is restricted to firm exposures to foreign banks only and in columns (5) and (6) this sample is restricted to bank-firm exposures that are strictly positive in the first period. Firm characteristics include total bank debt, and the number of relationship banks. Bank characteristics include the leverage ratio, the return on asset, and log of total assets. Relationship characteristics include the length and the size of the relationship. Both firm and bank characteristics are defined the year before the shock. Columns (2), (4), (5) and (6) include firm fixed effects. Standard errors are clustered at the bank and firm levels and reported in brackets, * p<0.10, ** p<0.05, *** p<0.01.
Table VII. The Effect of a Change in the Cost of Leverage on Bank Risk-Taking: Evidence from Borrower Characteristics - The Belgian ACE (2006)

<table>
<thead>
<tr>
<th></th>
<th>Ex-Ante Borrower Characteristics</th>
<th>Change in Borrower’s Characteristics (Δ Log)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bank Debt</td>
<td>Leverage</td>
</tr>
<tr>
<td>New Borrower</td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td></td>
<td>-0.47**</td>
<td>0.31</td>
</tr>
<tr>
<td></td>
<td>(0.22)</td>
<td>(1.02)</td>
</tr>
<tr>
<td>Treated Firm</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Industry FE</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Firm Characteristics</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Observations</td>
<td>1,055</td>
<td>355</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.004</td>
<td>0.000</td>
</tr>
</tbody>
</table>

This table investigates the characteristics of firms borrowing to Belgian banks following the introduction of the ACE. In columns (1) to (4) the sample is restricted to firms borrowing to Belgian banks. The dependent variable $NewBorrower$ indicates whether this firms is a new borrower to the affected banks. In columns (5) to (9) the sample covers all the firms for which we have detailed information from Ustan. We take the introduction of the ACE as an event and collapse all quarterly data one year before and two years after into a single pre- and post-event period. The dummy variables indicate firms that are borrowing from Belgian banks ex-ante (before the shock). Firm controls include total assets, total sales, ROA, leverage and debt structure before the reform. Standard errors are clustered at the firm-level and reported in brackets, * p<0.10, ** p<0.05, *** p<0.01.
Table VIII. Taxing Bank Debt, Bank Asset Mix and Risk Taking: Evidence from the Liability Tax Across European Countries (2009 - 2013)

<table>
<thead>
<tr>
<th>Equity to Assets Ratio</th>
<th>Loans to Assets Ratio</th>
<th>Risk Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log</td>
<td>Amount</td>
<td>Log</td>
</tr>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>Treated × Post</td>
<td>0.086***</td>
<td>0.797***</td>
</tr>
<tr>
<td>(0.008)</td>
<td>(0.074)</td>
<td>(0.073)</td>
</tr>
<tr>
<td>Size × Year</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Capital × Year</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Bank FE</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Controls</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Observations</td>
<td>6.245</td>
<td>6.245</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.910</td>
<td>0.910</td>
</tr>
</tbody>
</table>

This table analyzes the impact of the introduction of the Liability Tax in Europe on bank asset mix, capital structure and risk taking in a differences-in-differences setup over the 2003-2007 period. The dependent variable is the equity to asset ratio in columns (1) to (3), the loan to assets ratio in columns (4) to (6), the regulatory ratio in column (7), the ratio of risk weighted assets to total assets in column (8), the Z score in column (9) and the ratio of impaired loans in column (10). The table displays the coefficient of the interaction of the dummy variable Post - equal to one after the introduction of the ACE reform in 2005 - and the dummy Treated that indicates whether the bank is a treated bank. Models are estimated using OLS and include both bank and year fixed effects, time varying bank controls - Return on assets, log of total assets, log of total assets squared - and country controls - GDP per capita and GDP per capita growth rate. All these variables are lagged - and total asset is also lagged twice. The model also includes Year × ex-ante asset quintile fixed effects and Year × ex-ante leverage ratio quintiles in columns (1) to (6). Standard errors are clustered at the bank level.
Table IX. Taxing Bank Debt and the Asset Mix of Banks: Evidence from the Liability Tax in Slovakia (2011)

<table>
<thead>
<tr>
<th></th>
<th>Equity to Assets Ratio</th>
<th></th>
<th>Loans to Assets Ratio</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Log (1)</td>
<td>Amount (2)</td>
<td>Log (4)</td>
<td>Amount (5)</td>
</tr>
<tr>
<td>Treated x Post</td>
<td>0.149**</td>
<td>1.250**</td>
<td>1.415*</td>
<td>0.037**</td>
</tr>
<tr>
<td></td>
<td>(0.065)</td>
<td>(0.570)</td>
<td>(1.109)</td>
<td>(0.014)</td>
</tr>
<tr>
<td>Parent Bank x Year FE</td>
<td>-</td>
<td>-</td>
<td>Yes</td>
<td>-</td>
</tr>
<tr>
<td>Bank FE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Controls</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Observations</td>
<td>179</td>
<td>179</td>
<td>174</td>
<td>179</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.767</td>
<td>0.826</td>
<td>0.943</td>
<td>0.791</td>
</tr>
</tbody>
</table>

This table analyzes the impact of the introduction of the Liability Tax in Slovakia on the asset mix and risk taking of the Slovakian subsidiaries of European banks. The sample includes the subsidiaries of banks that are present in Slovakia and hence compare how these banks changed the capital structure and asset mix of their Slovakian subsidiaries compared to their other subsidiaries.