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Abstract

This paper shows that a reduction in tax discrimination between debt and equity funding leads to better capitalized financial institutions. The paper exploits exogenous variation in the tax treatment of debt and equity created by the introduction of a tax shield for equity. The results demonstrate that a more equal treatment of debt and equity increases bank capital ratios, driven by an increase in common equity. The change also leads to a significant reduction in risk taking for ex-ante low capitalized banks. Overall, the findings suggest that tax shields could be a valuable and innovative policy tool for bank regulators.

JEL: G21, G28, G32, H25 Keywords: Bank capital structure, Bank regulation, Tax shields

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1. Introduction

This paper investigates whether reducing the relative tax benefit of debt can be a valuable addition to existing bank capital regulation. The 2008-2009 financial crisis spurred both regulators and politicians around the world to rethink bank capital regulation. Ensuring that regulation contributes to proper risk-taking incentives and sufficient loss-absorbing capacity for financial institutions, however, remains a difficult task. This paper focuses on an often overlooked factor in the regulatory debate on bank capital: tax deductibility of interest expenses on debt. Following up on the seminal work of Modigliani and Miller (1958), both Stiglitz (1973) and King (1974) show theoretically that tax shields have an impact on corporate capital structures and thus ultimately on financial stability. Hence, reducing the unequal tax treatment of debt and equity could be an excellent addition to current capital regulation (Poole, 2009). Studying the direct impact of tax shields on bank capital structure, however, is a complicated task. Corporate tax shields tend to be relatively constant over time and changes to tax rates are more often than not part of a broader tax reform package, which makes it difficult to tease out the direct impact of tax shields. As a consequence, empirical evidence on the relation between tax shields and capital structure is mixed for non-financial corporations [1] and very limited for financial institutions.

To better understand the impact of tax shields on the capital structure decisions of financial institutions, I exploit an exogenous change in tax legislation in Belgium in 2006 that reduced the relative tax advantage of debt funding by creating a tax shield for equity, called the notional interest deduction (NID). The exogenous variation created by this change allows to identify the direct impact of the unequal tax treatment of debt and equity on bank capital levels, the implications for bank risk-taking behavior, and, ultimately, how changes to tax shields can contribute to better bank capital regulation.

The first main finding of this paper is that tax shields have a significant impact on bank capital structure

[1] See Graham and Leary (2011) for an excellent overview of the existing capital structure literature

decisions. The empirical identification of this finding relies on a difference-in-differences (DiD) approach that compares the evolution of the capital buffers of Belgian banks that were subject to the change in tax legislation with a group of matched banks in other European countries that did not experience such a change. Using this setup, I show that reducing the tax discrimination of equity funding vis-a-vis debt funding increases the equity ratio of the average treated bank in the baseline setup with 0.94 percentage points, which corresponds with an increase of more than 13 percent. This finding is depicted in Figure 1, which shows the evolution of the average equity ratio for the Belgian banks and the final control group of European banks between 2002 and 2007. Both groups have a very similar trend in their equity ratio during the pre-treatment period, while there is a strong increase in the average equity ratio of the Belgian banks in 2006 and 2007. The explanation for this finding can be found in the trade-off theory of capital structure, as creating a tax shield for equity decreases the marginal benefit of debt.

<insert Figure 1 around here >

Next, I investigate which factors are driving the change in equity ratios. Banks can increase their equity ratios either by increasing their equity, by decreasing their assets, or by a combination of both actions. The results in this paper indicate that the impact of the change in tax treatment is driven by an increase in bank equity and not by a reduction of activities. This result is crucial for at least four reasons. First, it confirms that the observed increase in equity ratios is most likely the consequence of the surge in the (relative) tax benefit for equity. Second, when considering tax shields as a regulatory policy tool, a bank regulator is interested in the channels through which the impact on equity ratios is realized. Due to the fragile economic recovery after the 2008-2009 financial crisis, a large part of the recent regulatory discussion on higher capital requirements focuses on whether they could harm the real economy through a reduction in bank lending. At the same time, a reduction in lending could be beneficial during periods of excessive lending or liquidity creation by banks (Acharya and Naqvi, 2012; Berger and Bouwman, 2014). Hence, it is vital to know where the change in equity ratios is coming from. Third, it indicates that the observed changes in equity ratios are unlikely to be driven by a reduction in loan demand due to the fact that the tax change also holds for non-financial firms. Fourth, this finding makes it highly unlikely that a heterogeneous pass-through of a contemporaneous increase in European Central Bank (ECB) policy rates during the treatment period is driving the main results.[2] Additional robustness tests (see Section 4) confirm this finding.

Besides focusing on the direct impact of taxes on bank capital structure, this paper addresses two important additional concerns that a regulator could have when contemplating the use of tax shields as an incentive mechanism to increase bank capital buffers: (i) whether both ex-ante low and high capitalized banks react to the change in tax treatment and (ii) what the impact is on bank risk behavior. The results in this paper indicate that both ex-ante low and high capitalized banks react similarly to the introduction of a tax shield for equity in terms of capital structure adjustments, but that they react differently in terms of risk-taking behavior. I observe a significant risk reduction for ex-ante low-capitalized banks after the introduction of the NID and no change in riskiness for ex-ante high capitalized banks.

Overall, this paper makes an important contribution to the capital structure literature by identifying the direct impact of tax shields on banks. Focusing on the banking sector not only is interesting from a capital regulation and general banking perspective, but also has some advantages compared with broad, inter-industry capital structure research. It can, for example, reduce potential problems of confounding inter-industry changes that make teasing out the impact of taxes on firm capital structure decisions difficult. Hence, this paper is well positioned to help settle the ongoing debate on the role of taxes as an important determinant of capital structure choices (See, e.g., Titman and Wessels, 1988; Fisher et al., 1989; Ang and Peterson, 1986; MacKie-Mason, 1990; Graham, 1996; Heider and Ljungqvist, 2015; Panier et al., 2013).

Within the banking literature, previous work on capital structure primarily focuses on the bank-specific determinants of (optimal) bank capital structure (Gropp and Heider, 2010; Flannery and Rangan, 2008; Berger et al., 2008) or on how banks make capital structure adjustments (De Jonghe and Öztekin, 2015;

[2]See, e.g., Van Leuvensteijn et al. (2013), Kok and Werner (2006), De Graeve et al. (2007) for evidence on the heterogeneous pass-through of monetary policy in the eurozone.

Memmel and Raupach, 2010; Francis and Osborne, 2012). Existing work on corporate tax rates and bank leverage mainly looks at correlations between tax rates and bank leverage in a cross-country setting (see, e.g., De Mooij and Keen, 2012; De Mooij et al., 2013; Horváth, 2013) or at correlations in the US (Ashcraft, 2008). Two exceptions are contemporaneous papers by Schandlbauer (2015) and Milonas (2015), which analyze the impact of state level tax changes on the capital structure of US banks and find a positive relation between taxes and bank leverage. However, important differences exist between these two studies and this paper. First, the fact that the NID came into effect due to a ruling of the European Commission means that this paper relies on an explicit, isolated, and exogenous change in tax shields.[3] This alleviates concerns that changing macroeconomic conditions or other tax legislation changes are simultaneously driving the tax reform and capital structure decisions, which could be a potential concern when analyzing corporate tax rate reforms.[4] Second, by analyzing the introduction of a tax shield for equity, this paper focuses on potential incentives to increase bank capital levels. Schandlbauer (2015) looks at the impact of tax increases on bank capital, which give banks an incentive to decrease capital levels. This is arguably less interesting from a capital regulation point of view.[5] Third, in contrast to most existing studies, this paper focuses on a direct and explicit policy tool and not on tax rate changes to study the importance of tax shields. As such, it provides valuable information for regulators who are considering alternative policy measures to induce higher equity ratios.

Finally, this paper also contributes to the literature on bank capital and risk taking. Existing theoretical work is undecided on whether higher bank capital leads to to more or less risk taking.[6] Existing empirical work either focuses on the impact of capital requirements on bank risk taking (Laeven and Levine, 2009),

[3]see Section 2 for more information on the exact changes in tax legislation.

[4]Kawano and Slemrod (2012), for example, show that tax reforms also tend to simultaneously affect the corporate tax base, potentially biasing the results of studies that look at the relation between tax rates and capital structure decisions.

[5]One would have to be willing to make the assumption that the impact of taxes on leverage is symmetric. Whether this assumption is correct is unclear. Heider and Ljungqvist (2015), for example, show that there is an asymmetric reaction to tax changes in the US, whereas Milonas (2015) finds symmetric reactions.

[6]See, e.g., Merton (1977); Koehn and Santomero (1980); Kim and Santomero (1988); Furlong and Keeley (1989); Holmstrom and Tirole (1997); Coval and Thakor (2005); Mehran and Thakor (2011)

on capitalization and performance during crisis periods (Berger and Bouwman, 2013; Demirgüç-Kunt et al., 2013) or on the impact of capital support measures during crisis periods (Giannetti and Simonov, 2013; Black and Hazelwood, 2013; Li, 2013; Berger et al., 2014; Duchin and Sosyura, 2014; Gropp et al., 2014). This paper contributes to this literature by analyzing the impact of an exogenous increase in capital ratios after a reduction in tax discrimination on bank risk behavior. The paper also illustrates the (indirect) impact of tax shields on bank risk behavior, which is a factor that is often neglected in existing work.[7]

The remainder of the paper is structured as follows. Part 2 provides detailed information on the notional interest deduction, Part 3 describes the data used throughout the paper and part 4 describes the methodology used and the results. In part 5, I perform a battery of robustness checks to ensure that the main results are not depending on the matching procedures or potential sample selection issues, not biased by potential omitted variables and not impacted by events occurring at the same time as the actual change in tax treatment. Part 6 summarizes the main conclusions.

2. The Belgian notional interest deduction

The main source of identification for this paper is the notional interest deduction, which is a tax reform that was introduced in Belgium in 2006. A feature that is common among most corporate income tax systems is that the cost of debt is deductible as an expenditure when calculating taxable profits, while this is not the case for dividends (Klemm, 2007). This discrimination against equity financing is a textbook example of a friction that can violate the Modigliani Miller theorem. To overcome this friction, Devereux and Freeman (1991) propose the implementation of an Allowance for Corporate Equity (ACE). An ACE allows firms to deduct a notional interest rate on their equity, which ideally should make firms indifferent in their choice between debt and equity, at least in terms of corporate tax implications.

In Belgium, an allowance for corporate equity came into practice through the introduction of the no-

[7] To the best of my knowledge, the only other empirical paper looking at taxes and bank risk is Horváth (2013), who shows a negative correlation between risk-weighted assets and corporate tax rates.

tional interest deduction (NID). Since 2006, Belgian firms and foreign firms permanently established in Belgium are allowed to deduct a notional return of their book value of equity.[8] The reason for introducing this deduction goes back to a ruling by the European Commission in 2003, which prohibited the existence of coordination centers. Between 1982 and 2003, Belgium had an advantageous tax legislation for subsidiaries (so-called coordination centers) of multinational firms whose only purpose was to provide financial and accounting services to their parent companies. The taxable income for these centers was not based on profits but on expenses less financial and salary costs. This, combined with a low tax rate for these subsidiaries, made Belgium a popular tax destination for many multinational firms. The ruling of the European Commission, however, prohibited this advantageous scheme, as it discriminated against Belgian firms. This led to the introduction of the notional interest rate deduction, which partly replaced the tax benefit for the multinational coordination centers with a notional interest deduction that is applicable to all firms incorporated in Belgium. This deduction thus created a tax shield for equity for Belgian firms.

The deduction equals the calculated average 10-year Belgian government bond rate of the year preceding the current fiscal year by two years, with a maximum set at 6.5 % and with the restriction that the rate cannot change by more than 1 percentage point year over year.[9] Hence, not the actual equity cost, i.e. the return to shareholders, but an estimated equity cost is tax deductible. Only one other country tried out a similar tax regime before Belgium: Croatia between 1994 and 2000.[10]

The current evidence on the impact of the NID in Belgium is scarce and mixed for non-financial corporations and non-existent for financial institutions. Kestens et al. (2011) use a non-random sample of firms

[8]The law was approved on June 30, 2005. However, given the many uncertainties and ambiguities surrounding the actual implementation, several adjustments were made in September and October 2005. In theory, firms and banks could thus have already started to make changes to their funding structure in November and December 2005. In practice, however, this is most likely too short notice to make substantial changes to the capital structure of the firm, as (i) it takes some time to get fully informed on the actual consequences of the new law and (ii) it takes time to implement capital structure choices. As such, this paper analyzes the impact from 2006 onwards, as also done by all other papers focusing on the introduction of the NID (See Kestens et al., 2011; Princen, 2012; Panier et al., 2013; Van Campenhout and Van Caneghem, 2013)

[9]During the first three years, for example, the rate was equal to 3.44, 3.78 and 4.31 %.

[10]The interest was called the protective interest: the deductible rate was set to 5% plus the inflation rate Three other countries tried out a related though different type of interest deduction on equity before: Italy (1997-2003), Austria (2000-2004) and Brazil (1996 to the present).

to perform a simulation study to analyze the impact of the tax change on small and medium enterprises. They find a significant reduction in leverage ratios. Princen (2012) addresses the impact of the change in tax treatment in Belgium on non-financial firms by comparing their reaction with a group of French and German firms, and finds a negative impact on firm leverage. Panier et al. (2013) confirm these findings when using a broader and better defined control group while also focusing on differences within the treatment group. Van Campenhout and Van Caneghem (2013), however, show that the NID did not affect the financing decisions of a group of small enterprises.

3. Data

The bank-specific balance sheet data used for the empirical analysis are retrieved from the Bureau van Dijk Bankscope database. I select all EU-27 bank holding companies, commercial, savings and cooperative banks that have data available for each year between 2002 and 2007 on all main variables used throughout the analysis. This period corresponds with four years before the implementation of the tax treatment and two years when the treatment was in place.[11] I limit the treatment period to two years, as this should reduce the possibility that I am measuring the impact of other shocks that have an impact on bank equity ratios, such as government support measures in 2008 or other crisis related events. To avoid double-counting, I remove the unconsolidated entries for banks that also report information at the consolidated level. For the set of Belgian banks I also remove banks that are 100 % owned by another Belgian bank in the sample. Subsequently, I winsorize all variables at the 2 % level to mitigate the impact of outliers. This selection leaves a starting sample of 33 Belgian banks and 2,851 other European banks, for which I have data between 2003 and 2007.[12]

The main variable of interest is the equity ratio, defined as total equity over total assets. Throughout the paper, a group of bank-specific characteristics are used as control variables in the capital structure re-

[11] in the DiD analysis, three pre-treatment periods are used, but I also gather data for 2002 as I use one-year-lagged control variables in the main setup.

[12] Robustness checks in subsection 4.3 show that relaxing these selection criteria does not have a impact on the final results.

gressions: bank size (defined as the log of total assets), profitability (proxied by return on assets), bank risk (proxied by the ratio of nonperforming loans over total loans), and bank diversification (proxied by the share of non-interest income in total income). To analyze the underlying drivers of the change in equity ratios, I use the amount of total loans, the share of retained income (defined as retained income over pre-tax profits), and the total amount of equity reserves. When focusing on bank risk behavior, I use three balance sheet risk measures and three loan portfolio risk measures. The three balance sheet measures are the nonperforming loans ratio, the standard deviation of return on assets (based on the returns between t-2 and t), and the Z-score. Each of these indicators is calculated using Bankscope data. The Z-score measures the distance to insolvency (Roy, 1952) and can be interpreted as the number of standard deviations by which returns would have to fall from the mean to wipe out all equity in the bank. A higher Z-score thus implies a more stable bank. The Z-score is calculated as the ratio of the sum of return on assets and the equity ratio over the standard deviation of the returns (over a three year window). It is frequently used as a measure of stability in the banking literature: see, e.g. Demirgüç-Kunt and Huizinga (2010); Houston et al. (2010); Laeven and Levine (2009); Beck et al. (2013). To obtain more detailed information on bank loans and bank loan portfolio risk, I make use of the Belgian corporate credit register and the Belgian Central Balance Sheet Office. For the period under analysis, the corporate credit register contains monthly data on all outstanding loans of banks active in Belgium to firms incorporated in Belgium, given that the total amount borrowed by the firm is larger than 25 thousand euro. For this paper, I use quarterly aggregates at the bank-firm level instead of monthly data. After linking the 33 banks to the register and removing banks that have on average fewer than 20 firms in their portfolio, I retain 22 banks in the sample for the risk analysis. Next, I obtain from the Central Balance Sheet Office balance sheet data for the firms that are borrowing from these banks. For each firm, I calculate its leverage ratio, interest burden (financial costs over cash flow), and the Altman Z-score. I then calculate weighted versions of these variables at the bank-quarter level for all new bank loans in a quarter, with the weights being the size of the loans. These three measures are then used as proxies for the riskiness of new loans granted by the banks. The part of the risk analysis that is based on loan data is thus performed at the bank-quarter level, in contrast with the other parts of the paper, in which bank-year data are used. The three macro-economic variables used throughout the analysis (GDP per capita growth, GDP per capita and a Consumer Price Index) are downloaded from the World Development Indicators database at the World Bank. Summary statistics for all these variables for the full 2003-2007 DiD sample period can be found in Panel B of Table 1. Definitions of all variables are listed in Table A2 in appendix.

<insert Table 1 around here >

4. Empirical analysis

This section describes the methodology used throughout the empirical analysis and presents the results. I first focus on the matching procedure and the difference-in-differences strategy that are used to come to consistent estimates of the impact of the change in tax treatment. After having established that the notional interest rate deduction impacts bank capital structure decisions through changes in equity, I focus on the heterogeneity in the impact of the tax shield across banks and on the consequences for bank risk taking.

4.1. Methodology:Difference-in-differences setup and matching

For the main analysis in this paper, I use a difference-in-differences setup, which compares the change in capital structure of the Belgian banks with the change in capital structure of a similar group of European banks for whom the tax environment did not change. The baseline setup is the following:

$$ETA_{i,t} = \alpha + \beta_1 * Treated_i + \beta_2 * Post_t + \beta_3 * Treated_i * Post_t + \beta_4 * X_{i,t-1} + \varepsilon_{i,t} \tag{1}$$

Where $ETA_{i,t}$ is the equity ratio of bank *i* at time *t*, defined as equity over total assets; $Treated_i$ is a dummy that equals one for all Belgian banks in the sample (treatment group indicator); $Post_t$ is a dummy indicator equal to one in the post-treatment period (2006-2007); and $X_{i,t}$ represents a group of control variables that are typically seen as important bank capital structure determinants. Including the $Treated_i$ dummy controls for any permanent, time-invariant differences between the treated and the control group. The $Post_t$ dummy controls for trends that are common to both groups. The main coefficient of interest is the coefficient for the interaction variable (β_3), as it shows the actual impact of the introduction of the NID. The difference-in-differences approach ensures that the estimates will not be biased by permanent differences between the treatment and the control group or by shared trends. Additionally, I also add time-varying bank specific capital structure determinants to assure that the estimates are not impacted by a contemporaneous shock to these characteristics. Existing work on bank capital structure determinants shows that smaller, more profitable and riskier banks tend to have higher equity ratios (See, e.g., Gropp and Heider, 2010; De Jonghe and Öztekin, 2015; Brewer et al., 2008). As such, I add proxies for bank profitability (return on assets), bank size (log of total assets) and bank risk (nonperforming loans). Two additional bank-specific variables (a non-interest income ratio and the ratio of total loans over total assets) are added to further control for the potential impact of bank business model choices on bank capital structure. Market based variables that could be related to bank capital structure decisions such a market-to-book ratios or dividend ratios are not included as only four of the Belgian banks in the sample are publicly traded. Finally, GDP per capita, the CPI rate, and GDP per capita growth are also included to control for potential differences in economic development at the country level.

The key identifying assumption for obtaining reliable difference-in-differences estimates is the parallel trend assumption. This assumption states that, in the absence of treatment, the average outcome for the treatment and control group would have followed parallel paths over time, which is hard to verify. However, given that this assumption also implies that the equity ratio has a similar trend for both groups in the pre-treatment period, I use a propensity score matching procedure to construct a control group of European banks, based on their trend in the equity ratio and other characteristics in the pre-treatment period (see, e.g., Angrist and Krueger, 1999; Roberts and Whited, 2012).

The matching procedure is a nearest neighbor matching of propensity scores, as first proposed by Rosenbaum and Rubin (1983). I start the matching procedure by running a probit regression for the full 2005 EU-27 sample. The dependent variable is a dummy equal to one for the Belgian banks. As explanatory variables I include both the lagged and the contemporaneous growth rates of the equity ratio in the pre-treatment period to make it more likely that the parallel trends assumption is fulfilled for the difference-in-differences model. Furthermore, I include bank size, two lags of the equity ratio and two macroeconomic control variables (GDP growth and the CPI rate) to make sure that the treatment and control groups are more balanced, which should limit the possibility that the measured change in equity ratios is due to other factors (Abadie, 2003). I then use the predicted probabilities of the probit model to match each Belgian bank with its three nearest non-Belgian neighbors.[13] The matching is done with replacement, which means that each non-Belgian bank can be used as a neighbor for multiple Belgian banks. Smith and Todd (2005) indicate that this should improve the accuracy of the matching procedure. The matching procedure leads to a final sample of 33 treated Belgian banks and 99 control group banks.[14] The impact of the matching procedure is illustrated in Panel A of Table 1. This panel shows summary statistics for the period before the introduction of the notional interest rate deduction (2003-2005) for the Belgian banks, the full sample of non-Belgian banks and the banks in the control group after the matching procedure. It also reports statistics on the reduction of the differences between the Belgian banks and the banks in the non-Belgian sample. The summary statistics indicate that the parallel trends assumption is violated when using the full sample of non-Belgian banks as a benchmark group, as the growth in the equity ratios in the pre-treatment period is significantly different compared with the Belgian banks. Furthermore, banks operating in Belgium also differ in terms of

[13] Additional robustness checks show that the results are not sensitive to changing the number of matched banks, see Table 5.

[14] The banks in the control group are headquartered in 11 European countries: Denmark, Finland, France, Germany, Greece, Italy, The Netherlands, Portugal, Romania, Spain and the United Kingdom. More information on the distribution of the banks over the different countries can be found in Table A1 in appendix.

a number of other characteristics. For example, Belgian banks are on average larger and have significantly lower equity ratios during the pre-treatment period. The success of the matching procedure is illustrated by two different indicators.

First, comparing the columns ”Bias full” and ”Bias matched” shows a strong decrease in the standardized percentage bias between the Belgian banks and, respectively, all banks in the full sample and the banks in the control group. The bias is the percentage difference of the sample means in the treated and non-treated subsamples 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). The column ”% change in bias” shows the percentage change in this bias after matching. A positive value implies that the averages are lying closer to each other after matching. Most important, this statistic shows a large reduction of 92% in the bias between the equity ratio growth rates in both groups, making it far more likely that the parallel trends assumption holds. The statistic also shows a large reduction in the bias for the majority of the variables after the matching procedure - ranging between 4% and 70%. Only for the loan ratio and for the nonperforming loans ratio there was no such improvement. Second, the P-values of a T-test on the averages in Table 1 illustrate less significant differences between the majority of the variables in the treatment and the control group after the matching procedure. Whereas bank characteristics such as equity ratio growth, bank size and the equity ratio are statistically different when comparing the Belgian banks with the full sample of EU-27 banks, this does not hold when comparing the Belgian banks with the matched control group. There are still some differences in terms of, e.g., asset structure (proxied by the loan ratio) and Z-score, but remember that the banks in both the control and the treatment group are not required to be exactly similar along all dimensions. The fact that the trend in the dependent variable is made similar is by far the most important prerequisite for the difference-in-differences analysis, and this is obtained through the matching procedure. Figure 1 depicts the evolution of the average equity ratio for the Belgian banks and the final control group of European banks between 2002 and 2007. The figure clearly shows that both groups have a similar trend in their equity ratio during the pre-treatment period.

4.2. *Results*

In this section I use the matched sample to analyze the difference in equity ratios between treated and non-treated banks. I am interested in the impact of the change in tax treatment in Belgium on bank capital structures. The matching exercise in Section 4.1 ensured that I have two comparable groups of banks. By using a difference-in-differences approach, I can also control for unobserved (non-time-varying) differences between both groups and for confounding time trends. I also add time-varying bank-and country-specific bank capital structure determinants to assure that my estimates of the impact of the NID are not affected by a contemporaneous shock to these characteristics. After this, the only remaining concern is that country-specific events happening contemporaneously with the change in tax legislation that also impact bank capital structure. Next to controlling for country-specific characteristics in the difference-in-differences setup, I perform several additional robustness checks to reduce this concern in subsection 4.3. Before coming to that, Section 4.2.1 and Section 4.2.2 describe the impact of the NID on bank capital structure, the heterogeneity in the treatment effect and the impact on bank risk taking behavior.

4.2.1. *The equity tax shield and bank capital structure: difference-in-differences results*

Table 2 shows the results for the difference-in-differences analysis that compares the evolution of the equity ratios of the Belgian banks with those of a control group of European banks. All standard errors are clustered at the bank level, unless explicitly mentioned otherwise. The first column of Table 2 reports the baseline result in a setup without bank fixed effects. I regress the equity ratio on a post-treatment dummy, a dummy equal to one for the Belgian banks, and an interaction term between the post-treatment dummy and the Belgium dummy. The variable of interest is the interaction term, as it captures the actual impact of the introduction of the tax shield for equity. The significant and positive coefficient of 0.94 indicates that the average equity ratio for Belgian banks increased significantly compared with what one would expect without the change in tax treatment. Figure 1 illustrates this finding. While the equity ratio of the banks in the control group further follows the pre-2005 trend, the equity ratio of the Belgian banks experiences a positive shock after the introduction of the NID. In the second column of Table 2, I incorporate a bank fixed effect, which further controls for unobservable bank-specific characteristics that could impact bank capital structure decisions. In the third column, the dependent variable is replaced by the natural logarithm of the equity ratio. The result in this column shows that the impact is also economically large, as the increase in the equity ratio of 0.94 percentage points corresponds with an increase of 13.5% for the average bank in the sample.[15]

<insert Table 2 around here >

Next, I make sure that potential shocks in one of the time-varying determinants of bank capital structure are not driving the results in Columns 4 to 7 of Table 2. More specifically, I add a group of bank- and country-specific control variables to the difference-in-differences setup. I add proxies for bank profitability (return on assets), bank size (log of total assets), risk (nonperforming loans), income and asset structure (non-interest income ratio and loans over total assets ratio), GDP per capita growth, CPI rate and the log of GDP per capita. The positive and significant coefficient on the interaction term of 1.076 in Column 4 indicates that the main result also holds when further controlling for observable changes over time of capital structure determinants. The results in Column 5 indicate that this corresponds with an increase in equity ratio of around 19.3% for the average Belgian bank. In Column 6, standard errors are clustered on the country level instead of on the bank level. Given that the treatment varies at the country level, it could be advisable to cluster at this level. However, the fact that the sample only includes ten countries makes these

[15]While the coefficient for a continuous variable in a log-linear equation can be directly interpreted as the percentage effect of that variable on the dependent variable, this is not the case for dummy variables. The appropriate transformation to get a similar interpretation for dummies is derived by Kennedy (1981):$\hat{p} = 100 * (exp[\hat{c} - 0.5 * \hat{V}(\hat{c})] - 1)$ where $\hat{p}$ is the percentage change in the dependent variable given a change in the dummy variable from zero to one, $\hat{c}$ is the coefficient estimate for the dummy variable, and $\hat{V}(\hat{c})$ is the estimated variance for this coefficient. It is this transformed coefficient that is always discussed in the text.

standard errors potentially unreliable. Nevertheless, it is reassuring to see that the main result also survives when clustering at the country level. Finally, for the regression in Column 7 of Table 2, the data is first collapsed into pre- and post-treatment averages at the bank level. More specifically, I take the 2004-2005 average and the 2006-2007 average for each bank in the sample. In previous regressions, clustering the error terms at the bank or country level took care of potential correlations in the error term. The setup in Column 7 allows to control for similar problems through averaging, which should also lead to correct standard errors (Bertrand et al., 2004). Using this approach, the impact of the change in tax treatment remains positive and highly significant, with a point estimate of 1.075.

Overall, the results in Table 2 show that the reduction of the unequal tax treatment of debt and equity has a significant and economically large impact on the capital structure of banks. On average, the equity ratio increases with around 13.5% for the Belgian banks in our sample, compared with what would be expected without the introduction of the NID. This finding indicates that, as for non-financial firms, (see Panier et al., 2013) - tax shields matter for the capital structure of banks. As such, reducing the relative tax advantage of debt financing can be used to induce banks to build up their capital buffers.

Next, I investigate which factors are driving this change in equity ratios. If the observed increase in capital buffers is driven by the increase of the (relative) tax benefit of equity, the change should be rather coming from an increase in equity instead of a reduction of activities.

Table 3 sheds more light on this issue. The first column indicates that the equity ratio for the Belgian banks is 13.5% higher than expected after the introduction of the notional interest deduction. Column 2 shows that this increase is driven by a rise in equity. Equity levels for the Belgian banks are on average 15.9% higher during the post-treatment period compared with what one would expect based on the evolution of the equity levels in the control group. In addition, Column 3 and 4 of Table 3 confirm that the increase in the equity ratios of the Belgian banks is not driven by a shrinking or slower growing balance sheet. No significant difference exists in the evolution of total assets or loans between the Belgian banks and the control group. The result in Columns 5 to 7 indicate how the higher amount of total equity is reached. The easiest way to increase equity levels is by retaining a larger share of profits in the bank instead of distributing it to shareholders. Column 5 shows that the NID leads to a significant rise in the share of retained income (defined as retained income over total pre-tax profits) for the Belgian banks with about 22.7% The NID gives banks an incentive to retain a higher share of their earnings. Column 7, however, illustrates that this rise did not lead to a stronger increase in total retained reserves for the Belgian banks. The main explanation is that profits rose faster for the control group banks, such that the higher retention rate for Belgian banks did not lead to a higher increase in retained earnings. Column 6 indicates that the non-retained earnings component of total equity also increased for the Belgian banks, although the effect is again insignificant. Overall, the results in this table indicate that the increase in equity ratios after the introduction of the NID is driven by an increase in total equity. Furthermore, while the NID potentially gave Belgian banks an incentive to retain a higher share of their earnings, the main driver for the difference in equity ratio growth rates between the Belgian banks and the control group could still be an increase in the non-retained earnings related component of total equity.[16] The data set at hand, however, makes it difficult to precisely estimate where the increase in equity is coming from, as the sub-components are not always available and as the actual split up is not always straightforward. However, the increase in the equity ratio is clearly driven by changes at the equity side and not by a decrease in activities. Hence, it indicates that the scope for negative spillovers on bank activities, for example an extra incentive to reduce lending during recessions or to expand lending during credit booms, is limited.

<insert Table 3 around here >

[16]This component includes actual shareholder capital, minority interests and other reserves. The data set at hand, however, does not allow me to make a further split up.

4.2.2. NID, heterogeneity in treatment, and the evolution of bank risk taking

This section analyzes two additional concerns a regulator could have when contemplating the use of tax shields as an incentive mechanism to increase bank capital buffers. First, regulators might be interested in whether different types of banks react similar to the reduction in tax discrimination. For example, if only high capitalized banks react to the policy change, then the reduction in tax discrimination would be less appealing compared with a situations in which it also impacts banks that ex-ante have a low capital buffer. Second, regulators might be interested in the impact on bank risk behavior. The analysis above indicates that the introduction of the NID significantly increases the equity ratio of financial institutions, and thus improves the cushion that banks have to absorb future losses. Additionally, this could also impact ex-ante risk-taking behavior. Theoretical work on this topic shows that higher capital reduces asset-substitution moral hazard (Merton, 1977; Furlong and Keeley, 1989; Coval and Thakor, 2005) and strengthens a banks' incentive to monitor, as shareholders of better capitalized banks have more to lose from bank failure (see, e.g., Holmstrom and Tirole, 1997; Mehran and Thakor, 2011). On the other hand, another strand of theoretical literature argues that higher capital requirements could lead to an increase in bank risk taking (see, e.g., Koehn and Santomero, 1980; Kim and Santomero, 1988). To shed more light on these issues, the first five columns of Table 4 show the impact of the NID on the equity ratio, the Z-score, and the standard deviation of the return on assets, conditional on a banks' pre-treatment equity ratio.

<insert Table 4 around here >

The first column of Table 4 retakes the baseline result, indicating that the equity ratio is around 13.5% higher (compared with the control group) for the average Belgian bank after the reduction in tax discrimination. The second column shows the underlying heterogeneity in this result. The regression in the second column includes interaction terms between the Treated and Post dummy and the pre-treatment (2005) equity ratio. This ratio is normalized to have zero mean and unit variance, such that the Treated x Post dummy shows the impact for the average bank, while the coefficient on the interaction term with the equity ratio indicates the impact of a standard deviation change in the ex-ante equity ratio. The results in the second column of Table 4 indicate that the impact of the policy change on the capital buffer is not significantly different for banks that are a standard deviation away from the average equity ratio compared with the average bank. Put differently, both high and low capitalized banks react similar to the NID in terms of equity ratio growth. Column 3 of Table 4 illustrates the impact of the policy change on overall bank stability, proxied by the logarithm of the Z-score. The significant coefficient for the Treated x Post interaction indicates a significant change in Z-score for the average Belgian bank. However, the negative coefficient for the interaction term with the standardized equity ratio implies that low capitalized banks experience a more positive shock in the Z-score and thus in their overall stability. A similar result is found in Column 4, where the dependent variables is the (3 year) standard deviation of returns. The results in Column 4 imply that there is no significant difference in the volatility of returns for the average bank (although the coefficient is negative), while there is a significant 16.7% reduction in volatility for banks that are a standard deviation below the average equity ratio. As the equity ratio variable is normalized, the coefficient for the Treated x Post interaction shows the impact for the average bank (-0.062). The coefficient of 0.095 for the interaction term with the standardized equity ratio implies that the impact for a bank that is one standard deviation below the average equity ratio is equal to -0.157 (-0.062 minus 0.095) , which is significantly different from zero (T-statistic =2.13, not reported) and corresponds with a 16.7% reduction.[17] In contrast, the impact for a bank that is one standard deviation above the average equity ratio is 0.032, which corresponds with a 2.9 percentage increase but is not statistically different from zero (T-statistic=0.412, not reported). The fifth column of Table 4 illustrates that the percentage of nonperforming loans is significantly lower for the average Belgian bank after the introduction of the NID, although no significant differences exist between high and low capitalized banks

[17]as explained above, coefficients for dummy variable need to be transformed if we want to interpret in terms of the percentage impact on a dependent variable. The appropriate transformation is given by Kennedy (1981): $\hat{p} = 100 * (exp[\hat{c} - 0.5 * \hat{V}(\hat{c})] - 1)$ where $\hat{p}$ is the percentage change in the dependent variable given a change in the dummy variable from zero to one, $\hat{c}$ is the coefficient estimate for the dummy variable and $\hat{V}(\hat{c})$ is the estimated variance for this coefficient.

here.

The advantage of working with widely used risk measures such as the Z-score, the NPL ratio, and the volatility of returns is that they can be easily calculated for a large group of banks. A potential disadvantage is that they are rather crude proxies for bank risk. Therefore, while the first part of Table 4 focuses on the evolution of these risk indicators for Belgian banks relative to the evolution in the control group, the second part contains information on the evolution over time of the riskiness of the loan portfolios of the Belgian banks. As I have credit data available only for Belgian banks, a difference-in-differences setup is not possible. The advantage, however, is that these credit data allow me to construct more detailed (credit) risk measures, which is an interesting addition to the risk analysis in the first part of Table 4. For each bank, I calculate portfolio-weighted versions of the leverage ratio, interest burden (financial costs over cash flow), and the Altman Z-score for all new loans in its portfolio in each quarter. The idea is that the risk characteristics of firms that enter the loan portfolio of a bank contain valuable information on the risk-taking decisions of that bank. The coefficients for the post dummies in Columns 5 to 7 of Table 4 show the change in riskiness after the introduction of the NID for the average bank in the sample, while the coefficient on the interaction term of the post dummy with the standardized equity ratio shows the impact of a standard deviation change in the pre-NID equity ratio. The results confirm the findings from the cross-country analysis. Banks with ex-ante lower equity ratios exhibit a significant decrease in risk-taking. More specifically, the weighted leverage ratio and the interest burden of new loans entering the loan portfolio of low capitalized banks are significantly lower than the ones for the average bank. Similarly, the weighted Altman Z-score of their new loans is higher, which indicates that they are lending to firms with lower default probabilities.

Overall, the results in Table 4 indicate a decrease in riskiness for the low and medium capitalized Belgian banks after the introduction of the NID, but not for higher capitalized banks. A potential explanation for this finding is that there are diminishing returns to the screening and monitoring of borrowers. Higher capital ratios lead to a stronger incentive for the bank to screen and monitor borrowers, but these efforts become increasingly more costly. Put differently, a bank with ex-ante low screening and monitoring incentives can gain much in terms of (credit) risk reduction, whereas the expected gain for a bank that already heavily invests in monitoring and screening is significantly lower. This finding is in line with the assumption of a convex cost function of bank monitoring (see, e.g., Besanko and Kanatas, 1993; Carletti, 2004), illustrating that it is increasingly difficult for a bank to find out more and more about a firm.

4.3. Robustness

In this subsection, I employ several robustness tests to ensure that the main results do not depend on the specific matching procedure and are not biased by potential omitted variables or by events taking place at the same time as the change in tax treatment. I make use of different matching setups, I make sure that the results are not driven by sample selection or outlier issues, and I perform placebo studies indicating that the results do not hold when using a false treatment date. All these additional tests lend further support to the main results.

4.3.1. Matching and sample selection- Robustness

Table 5 contains a first batch of robustness tests. For each robustness test, the results for the fixed effect setup with the logarithm of the equity ratio as dependent variable, including the bank-specific and country-specific control variables, similar to Column 5 in Table 2, are reported.

<insert Table 5 around here >

In the first two columns of Table 5, I change the number of matched banks. In the baseline setup, I match each Belgian bank with three other EU-27 banks. Columns 1 and 2 of Table 5 show that the results are not sensitive to changing the number of matches, as they indicate a positive and significant impact of the tax change on the equity ratio. Using only one match for each bank or five matches for each bank again leads to a positive impact of the tax treatment, ranging between 19% and 23%.

For the regressions in Column 3 of Table 5, I expand the set of matching variables. In the baseline setup, I use the growth rate of the equity ratio, the equity ratio, bank size, and a group of macroeconomic indicators as matching variables. Here, I expand this set of variables with a group of bank-specific characteristics: bank profitability (return on assets ratio), bank risk (standard deviation of returns), non-interest income share, collateral (fixed assets over total assets), and a loan ratio (total loans over total assets). The regression results show that expanding the group of matching variables has no significant impact on the initial result. The impact of the tax treatment again lies around 13% and remains significant. In Column 4 I restrict the number of countries from which the control group banks are selected to the three largest neighbors of Belgium (Germany, France, and the Netherlands) to control better for common macroeconomic shocks in the treatment and the control group. Again, this change does not qualitatively alter the main result, as I now find an impact of the NID of about 15%. In Column 5 I redo the matching analysis on a sample that excludes the country from which the majority of banks in the control group is coming from (Italy, see Table A1). This ensures that the results are not driven by a large group of banks coming from a particular country.[18] I again find a positive and significant impact of the NID of around 10%.

In the next column of Table 5, I perform a placebo test by assuming that the NID came into effect in 2000 instead of 2006.[19] As the change in tax discrimination did not take place in this year, the estimated treatment effect should not be significantly different from zero. If not, then the difference-in-differences strategy is most likely picking up other unobservable differences between the treatment group and the control group, and the estimation of the impact of the change in tax discrimination potentially is biased. I rerun the matching analysis based on the observations the year before the false treatment date, which is similar to the

[18]in the robustness sample, the majority of the control group banks are coming from Germany (45), France (11) and the UK (6).

[19]in an unreported specification, I do a similar analysis but with 2003 as the false treatment date. The results are again insignificant.

procedure used in the initial analysis. I again require that all banks in the sample have data available for three years before the treatment and two years after, similar to the baseline setup. The results in Column 6 of Table 5 indicate no significant impact of the false treatment on the equity ratio, which lends further support to the viability of the difference-in-differences setup. In addition, this placebo study is a very interesting test, as the evolution of the ECB policy rate in 2000 was very similar to the one during the actual event period in 2006-2007. The ECB policy rate rose from 2% to 3.75% between November 1999 and October 2000, which is similar to the increase from 1.00% to 3.25% in 2006-2007. Previous work on the monetary transmission mechanism in the eurozone has shown that the transmission of policy rates to the actual rates that banks charge can vary for different countries and different types of banks (see, e.g., Van Leuvensteijn et al., 2013; Kok and Werner, 2006; De Graeve et al., 2007). Higher policy rates are expected to have a negative impact on loan growth, and lower loan growth could reduce overall growth in total assets. This normally happens at a different speed in different countries. Thus, the rising policy rate can increase the denominator of the equity ratio, leading to higher equity ratios due to changes in monetary policy. The fact that I do not find a significant rise in the equity ratios of Belgian banks during a period with a similar change in monetary policy rates makes it less likely that the increase in equity ratios is driven by changes in monetary policy rates. In addition, the fact that no significant difference exists between the treatment and the control group in terms of loan growth after the introduction of the NID (see Table 3, Column 4) further corroborates this finding. Finally, the last column of Table 5 is similar to the baseline regression, but includes a larger sample of banks. For this robustness check, I relax the data requirements for the banks used in the sample and require only that data is available for at least four years (with a minimum of one year for the post period), which increases the number of available Belgian banks from 33 to 42. The results show that the positive impact of the notional interest rate deduction also hold in this broader sample, as I find a significant increase in equity ratio for these banks of 13%.

4.3.2. Expectations and outliers

A final set of robustness checks ensures that the main results are not driven by mergers and acquisitions in Belgium during the treatment period, or by potential changes during the last year before the treatment, or by a group of outlier banks in either the treatment or the control group.

In the first four columns of Table 6, I study the impact of potential outliers on the main result. In the first column, I exclude bank-year observations for Belgian banks that were involved in takeovers during the treatment period, which could cause shocks to the equity ratio that have no relation with the NID and thus could bias the results. In practice, this means that I exclude four bank-year observations from the treatment period. In the second column, I remove the 10% of Belgian banks that had the largest growth in equity ratios after the introduction of the NID compared with their growth rate before the introduction. In this way, I make sure that my results are not driven by only three or four Belgian banks with the biggest shock in equity ratios. The sample specification for the regression in Column 3 is similar to the one in Column 2, but I now also remove the 10% of control group banks that had the lowest growth rate in equity ratios after the introduction of the NID. In the fourth column, I combine the two restrictions from Column 2 and 3. The results in these four columns indicate that the main findings are not driven by these mergers or by the banks with extreme growth rates in equity ratios. I still find a significant positive impact of the NID on equity ratio growth ranging between 14.7% and 20%, compared to an impact of around 19.3% in the main analysis (see Column 5 of Table 2). Finally, in the last column of Table 6, I remove the observations for 2005, as they could already be impacted by the announcement of the tax change taking place from 2006 onward. The result remain close to the baseline result in Column 5 of Table 2, with a significant point estimate of the impact of the NID of 20.3 %.

<insert Table 6 around here >

5. Conclusion

As previous financial crisis periods, the '08-'09 crisis triggered an extensive and worldwide debate on bank capital regulation. An often overlooked factor in this regulatory discussion on bank capital is the tax deductibility of interest expenses on debt. This paper documents the impact of tax shields on bank capital structure by taking advantage of exogenous variation in the tax treatment of debt and equity created by the introduction of a tax shield for equity in Belgium. It offers three main conclusions. First, reducing the relative tax advantage of debt has a strong and positive impact on bank equity ratios. Using a difference-in-differences approach that compares the evolution of the equity ratios of Belgian banks with a matched control group of European banks, I show that the equity ratio of the average Belgian bank increases with around 13.5% after the introduction of the tax shield for equity. Second, the impact of the change in tax treatment is driven by an increase in bank equity and not by a reduction of activities. This is important as it indicates that the scope for unintended side effects on bank activities is limited. Third, this paper also illustrates a decrease in riskiness for the ex-ante low capitalized Belgian banks after the introduction of the tax shield for equity, while this was not the case for ex-ante high capitalized banks. An explanation for this finding is that there are diminishing returns to the screening and monitoring of borrowers. Higher capital ratios lead to a stronger incentive for the bank to screen and monitor borrowers, but these efforts become increasingly more costly.

Overall, the results in this paper contribute both to the long-lasting discussion on the impact of tax shields on capital structure decisions and to the regulatory debate on bank capital regulation. The findings suggest that a reduction in the tax discrimination between debt and equity funding could be an important part of a regulatory incentive scheme that leads to better capitalized financial institutions. Furthermore, the findings indicate that this increase in capital levels reduces bank risk taking incentives for ex-ante low capitalized banks. Hence, the reduction in tax discrimination not only increases capital buffers for all banks, but also decreases risk-taking behavior for exactly those banks that regulators would want to target.

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Tables and Figures

Figure 1: Evolution of the equity ratio for the Belgian banks and the control group of banks

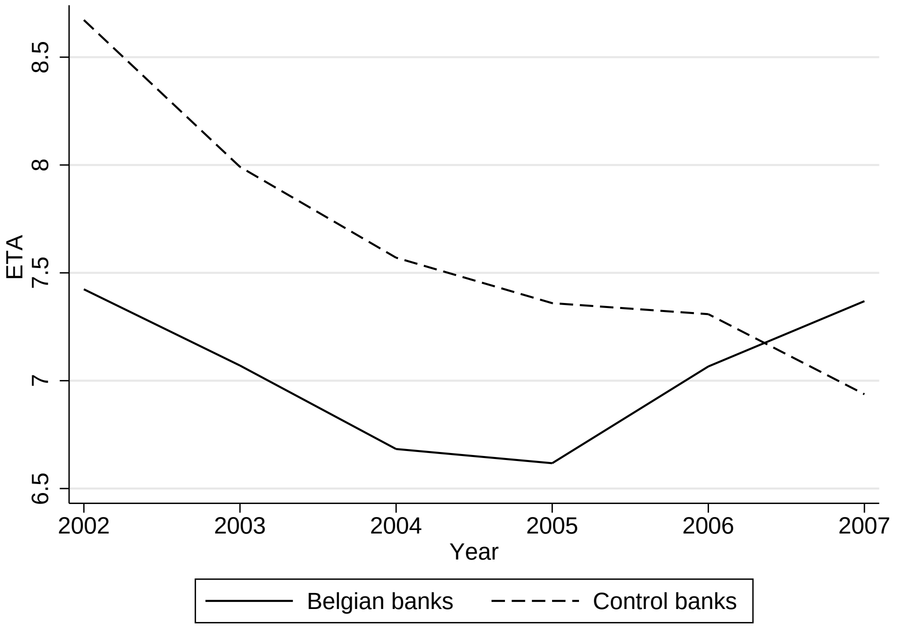

Table 1: Propensity score matching diagnostics and summary statistics

This table reports summary statistics and matching diagnostics for the pre-treatment period (2003-2005) and the summary statistics for the full sample period (2003-2007) for the main variables after the matching procedure. Panel A illustrates summary statistics and matching diagnostics for the pre-treatment period. The left hand side part of panel A shows the summary statistics for the Belgian banks, the middle part focuses on the full sample of non-Belgian banks and the right hand side part shows information for the non-Belgian banks selected for the control group. The fourth column of the second and the third part reports the p-value for a t-test that, respectively, checks whether the average for the full sample of non-Belgian banks or for the banks in the control group is equal to the average value for the Belgian banks. The columns 'Bias full' and 'Bias matched' show the standardized percentage bias between the Belgian banks and respectively all banks in the full sample and the banks in the control group. 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). The column % change in bias shows the percentage change in this bias after matching. A positive value implies that the averages are lying closer to each other after matching. Panel B shows the summary statistics for the full sample period (2003-2007) for the main variables after the matching procedure. The sample consist of a treatment group of 33 Belgian banks and a control group of 99 other European banks.

Panel A	*Propensity score matching diagnostics*													
	Treatment group		Full sample					Control group						
	N	Mean	N	Mean	Diff.	P-value	Bias full	N	Mean	diff.	P-value	Bias matched	% change in bias
Equity ratio - growth	99	-1.41	8289	2.62	4.03	0.04	-0.20	297	-1.70	-0.29	0.89	0.02	92.16%
Equity ratio	99	6.79	8289	8.92	2.13	0.00	-0.34	297	7.64	0.85	0.15	-0.19	45.43
ln(Total assets)	99	8.22	8289	6.88	-1.34	0.00	0.72	297	8.59	0.37	0.12	-0.18	75.76
Return on assets	99	0.56	8289	0.62	0.06	0.52	-0.07	297	0.60	0.05	0.58	-0.07	4.11
Loan ratio	99	0.37	8289	0.60	0.23	0.00	-1.00	297	0.63	0.26	0.00	-1.32	-31.63
Non-interest income share	99	0.33	8289	0.31	-0.03	0.32	0.12	297	0.35	0.02	0.53	-0.08	29.66
ln(sd(Return on assets))	98	0.28	8150	0.18	-0.10	0.00	0.39	288	0.19	-0.09	0.01	0.34	11.86
ln(Z-score)	97	3.52	7916	4.37	0.85	0.00	-0.64	287	4.07	0.55	0.00	-0.42	34.22
Nonperforming loans	99	0.00	8289	0.01	0.01	0.00	-0.48	297	0.01	0.01	0.00	-0.80	-65.77
GDP per capita - growth	3	1.44	78	3.43	2.00	0.09	-0.89	33	1.88	0.44	0.62	-0.26	70.69
CPI rate	3	2.29	78	3.07	0.78	0.13	-0.45	33	2.91	0.62	0.30	-0.32	30.62
ln(GDP per capita)	3	10.07	78	9.40	-0.67	0.00	1.10	33	9.72	-0.35	0.01	0.67	39.11

Panel B	**Summary statistics**				
	N	Mean	Std. Dev.	p10	p90
Equity ratio	660	7.32	3.96	3.44	10.63
ln(Total assets)	660	8.63	2.17	5.91	11.63
Return on assets	660	0.63	0.63	0.12	1.24
Loan ratio	660	0.58	0.22	0.21	0.82
Non-interest income share	660	0.34	0.18	0.15	0.54
Nonperforming loans	660	0.02	0.03	0.00	0.05
ln(sd(Return on assets))	650	0.20	0.21	0.03	0.46
ln(Z-score)	646	3.91	1.13	2.50	5.31
ln(Equity)	660	5.90	1.96	3.56	8.83
ln(Equity reserves)	420	4.70	2.63	1.28	8.68
ln(Other equity)	482	5.33	2.16	2.83	8.67
ln(Retained earnings)	580	0.53	0.73	-0.02	1.55
ln(Loans)	660	7.91	2.40	4.89	11.22
GDP per capita - growth	60	2.26	1.95	0.14	4.65
CPI rate	60	2.85	2.17	1.18	4.20
ln(GDP per capita)	60	9.78	0.69	9.35	10.27

Table 2: difference-in-differences regressions

This table analyzes the impact of the change in tax regulation in a difference-in-differences setup. The sample period is 2003-2007. The first column shows the regression of the equity ratio (ETA) on a post-event dummy that equals one in 2006-2007 (Post), a dummy indicating whether the bank is a Belgian bank (Treated) and an interaction term between both dummies that captures the actual impact of the tax change. In the first column, the model is estimated using OLS. In the second column, bank fixed effects are added, which make the Treated dummy obsolete, as it does not change within a bank. In the third column, the dependent variable is the natural logarithm of the equity ratio. Column 4 and 5 are similar to Column 2 and 3, but with the addition of a group of bank- and country-specific control variables. In the sixth column, standard errors are clustered at the country level instead of at the bank level. In the seventh column, I compare the difference in the average equity ratio over the 2004-2005 period with the average ratio over the 2006-2007 period between the treatment and the control group. For the regression in which the dependent variable is in logs, note that, while the coefficient for a continuous variable in a log-linear equation can be directly interpreted as the percentage effect of that variable on the dependent variable, this is not the case for dummy variables. The appropriate transformation to get a similar interpretation for dummies is derived by Kennedy (1981):$\hat{p} = 100 * (exp[\hat{c} - 0.5 * \hat{V}(\hat{c})] - 1)$ where $\hat{p}$ is the percentage change in the dependent variable given a change in the dummy variable from zero to one, $\hat{c}$ is the coefficient estimate for the dummy variable and $\hat{V}(\hat{c})$ is the estimated variance for this coefficient. It is this transformed variable (which only slightly deviates from the estimated coefficient for our estimations) that is always discussed in the text. Standard errors are clustered at the bank level, with the exception of Column 6, in which they are clustered at the country level. ***, ** and * denote p<0.01, p<0.05 and p<0.1 respectively.

	(1) ETA	(2) ETA	(3) ln(ETA)	(4) ETA	(5) ln(ETA)	(6) ln(ETA)	(7) Average ETA
Treated x Post	0.945***	0.945**	0.128**	1.076***	0.178***	0.178***	1.075***
	(0.345)	(0.385)	(0.0493)	(0.403)	(0.0531)	(0.0193)	(0.375)
Post	-0.518***	-0.518***	-0.0574***	0.354**	0.0133	0.0133	-0.170
	(0.168)	(0.188)	(0.0176)	(0.138)	(0.0159)	(0.0174)	(0.407)
Treated	-0.850						
	(0.997)						
Total assets				-0.808***	-0.121***	-0.121***	-1.487***
				(0.192)	(0.0262)	(0.0369)	(0.413)
Return on assets				-0.441*	-0.0554**	-0.0554	-0.0691
				(0.227)	(0.0255)	(0.0329)	(0.260)
Loan ratio				-0.742	-0.0342	-0.0342	2.702
				(1.151)	(0.148)	(0.134)	(1.792)
Non-interest income share				0.202	0.160	0.160**	-0.0855
				(1.225)	(0.171)	(0.0707)	(1.686)
Nonperforming loans				0.859	0.0652	0.0652	5.301*
				(2.382)	(0.304)	(0.284)	(3.022)
GDP per capita - growth				0.220***	0.0246***	0.0246**	0.313**
				(0.0681)	(0.00885)	(0.00991)	(0.140)
ln(GDP per capita)				-19.85***	-1.861***	-1.861***	-9.976*
				(3.503)	(0.398)	(0.357)	(5.130)
CPI rate				0.386***	0.00215	0.00215	0.759***
				(0.0890)	(0.00919)	(0.0105)	(0.110)
Constant	7.640***	7.428***	2.041***	208.7***	21.32***	21.32***	114.6**
	(0.348)	(0.0657)	(0.00700)	(34.66)	(3.975)	(3.419)	(50.33)
No. of observations	660	660	660	660	660	660	264
R-squared	0.002	0.891	0.866	0.930	0.892	0.892	0.940
Bank FE	No	Yes	Yes	Yes	Yes	Yes	Yes
Cluster level	Bank	Bank	Bank	Bank	Bank	Country	Bank

Table 3: Equity ratio: components

This table analyzes the underlying drivers of the equity ratio after the introduction of the notional interest rate deduction. The sample period is 2003-2007. The Post dummy equals one in 2006-2007, the Treated dummy equals one for the Belgian banks. The first column retakes the baseline result from Table 5. Columns 2, 5, 6 and 7 analyze the impact on equity and its sub-components, while Columns 3 and 4 look at the impact on the asset side. All left hand side variables are in natural logarithms. Retained income share is the ratio of retained income over after-tax profits. All regressions include bank-fixed effects, standard errors are clustered at the bank level. ***, ** and * denote p<0.01, p<0.05 and p<0.1 respectively.

	(1) ln(ETA)	(2) ln(Equity)	(3) ln(Total assets)	(4) ln(Loans)	(5) ln(Retained Earnings)	(6) ln(Other equity)	(7) ln(Equity reserves)
Treated x Post	0.128**	0.151**	0.0151	0.0778	0.211**	0.214	-0.137
	(0.0493)	(0.0758)	(0.0609)	(0.0759)	(0.100)	(0.207)	(0.347)
Post	-0.0574***	0.262***	0.318***	0.414***	-0.204***	-0.123	1.171***
	(0.0176)	(0.0243)	(0.0317)	(0.0360)	(0.0603)	(0.101)	(0.131)
Constant	2.041***	5.783***	8.497***	7.835***	0.595***	5.466***	3.942***
	(0.00700)	(0.0102)	(0.0108)	(0.0127)	(0.0200)	(0.0301)	(0.0457)
No. of observations	660	660	660	660	580	482	420
R-squared	0.893	0.991	0.992	0.992	0.210	0.947	0.886
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster level	Bank	Bank	Bank	Bank		Bank	Bank

*** p<0.01, ** p<0.05, * p<0.1

Table 4: Heterogeneity in the treatment effect and bank risk behavior

This table illustrates the difference in impact of the notional interest deduction between banks conditional on their pre-treatment equity ratio.The sample period is again 2003-2007. The Post dummy equals one in 2006-2007, the Treated dummy equals one for the Belgian banks. The first five columns of the table show the impact of the NID on the equity ratio (ETA), the Z-score, the standard deviation of the return on assets and nonperforming loans by applying a difference-in-differences setup. From Column 2 onwards, the regressions make a distinction between the impact on (ex-ante) high and low capitalized banks by interacting the treated and post dummy with a pre-treatment equity ratio. The pre-treatment equity ratio is standardized to have zero and unit variance. The Z-score is the ratio of the sum of the equity ratio and return on assets over the standard deviation of the returns. The standard deviation of the returns is calculated over a three year period. nonperforming loans is the ratio of nonperforming loans over total loans. The last three columns show the evolution of three loan-portfolio risk measures for the Belgian banks, based on characteristics of firms entering the loan portfolio of a bank (on a quarterly basis). The three risk measures are a weighted leverage ratio, a weighted Altman Z-score and a weighted debt burden variable (defined as a firms' financial costs over cash flows). Weights are based on loan size. All regressions include bank fixed effects, standard errors are clustered at the bank level. ***, ** and * denote $p<0.01$, $p<0.05$ and $p<0.1$ respectively.

	Bank characteristics					Loan portfolio characteristics		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	ln(ETA)	ln(ETA)	ln(Z-score)	ln(sd(Return on assets)	ln(NPL)	ln(Leverage)	ln(Altman Z)	ln(Interest burden)
Treated x Post	0.152**	0.152**	0.492*	-0.062	-0.018***			
	(0.059)	(0.059)	(0.261)	(0.054)	(0.004)			
Treated x Post x ETA '05		-0.043	-0.382*	0.095*	-0.006			
		(0.049)	(0.198)	(0.054)	(0.004)			
Post x ETA '05		-0.011	-0.102	0.009	0.006	0.049***	-0.056***	0.029**
		(0.027)	(0.095)	(0.021)	(0.004)	(0.014)	(0.020)	(0.013)
Post	-0.067***	-0.067***	-0.182*	-0.015	0.020***	-0.029	-0.006	-0.034
	(0.020)	(0.020)	(0.100)	(0.020)	(0.003)	(0.025)	(0.051)	(0.026)
Constant	1.886***	1.886***	3.927***	0.215***	0.011***	0.467***	0.632***	0.256***
	(0.008)	(0.008)	(0.039)	(0.008)	(0.001)	(0.010)	(0.021)	(0.011)
No. of observations	660	660	646	650	660	375	350	375
R-squared	0.860	0.860	0.473	0.470	0.478	0.160	0.173	0.250
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster level	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank

Table 5: Robustness - Matching, placebo tests and sample selection

This table includes six robustness checks for the difference-in-differences results. For each robustness check, the dependent variable is the natural logarithm of the equity ratio. All regressions include the same set of control variables as used in the baseline setup in Table 2, Column 5. Standard errors are again clustered at the bank level. As for the main analysis, the sample period is 2003-2007. For the first robustness check (Columns 1 and 2) I match each bank in the treatment group with either one or five non-treated banks instead of three. For the second robustness check (Column 3) I use a broader set of matching variables. In Column 4, I restrict the countries from which the control group banks are selected to the three biggest neighbors of Belgium, being France, Germany and the Netherlands. In Column 5, I remove the country from which the majority of the control group banks are coming from (Italy) from the sample and redo the matching analysis. In Column 6 I perform a placebo study in which I assume that the treatment took place in 2000 instead of 2006. For the regressions in the last column the data availability restrictions made when selecting the sample are relaxed, which leads to a larger (unbalanced) sample of 42 Belgian banks instead of 33. ***, ** and * denote $p<0.01$, $p<0.05$ and $p<0.1$ respectively.

	1 Match	5 Matches	Match variables	Control countries	Control countries	Placebo	Extended sample
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	ln(ETA)	ln(ETA)	ln(ETA)	ln(ETA)	ln(ETA)	ln(ETA)	ln(ETA)
Treated x Post	0.214***	0.179***	0.118**	0.137*	0.0953*	-0.0733	0.130***
	(0.0704)	(0.0607)	(0.0500)	(0.0725)	(0.0520)	(0.0490)	(0.0477)
Post	0.00489	0.0263*	0.00718	0.0399	0.0368	-0.0485	0.0218
	(0.0307)	(0.0146)	(0.0228)	(0.0368)	(0.0240)	(0.0380)	(0.0215)
ln(Total assets)	-0.195***	-0.156***	-0.0665*	-0.105*	-0.221***	-0.188**	-0.147***
	(0.0592)	(0.0359)	(0.0394)	(0.0578)	(0.0824)	(0.0761)	(0.0359)
Return on assets	-0.0412	-0.0510**	-0.0134	0.0143	0.00853	0.0102	-0.0164
	(0.0327)	(0.0231)	(0.0202)	(0.0117)	(0.0175)	(0.0311)	(0.0169)
Loan ratio	0.214	-0.0708	-0.0591	0.237	0.216	-0.385	0.234
	(0.318)	(0.148)	(0.0909)	(0.267)	(0.258)	(0.377)	(0.286)
Non-interest income share	0.132	0.220	0.230	-0.546	0.197	-0.0817	0.0995
	(0.313)	(0.169)	(0.152)	(0.363)	(0.167)	(0.181)	(0.171)
Nonperforming loans	0.314	0.0634	0.490	-0.442	0.493	-0.622	0.187
	(0.892)	(0.248)	(0.389)	(0.951)	(1.056)	(1.381)	(0.428)
GDP per capita - growth	0.0359***	0.0243***	0.00636	0.0331	0.0236***	-0.0183	0.0338***
	(0.0123)	(0.00887)	(0.00845)	(0.0242)	(0.00721)	(0.0193)	(0.00938)
ln(GDP per capita)	-1.955**	-1.619***	-0.925*	-2.067	-0.794	1.762***	-1.455**
	(0.862)	(0.589)	(0.557)	(2.131)	(0.585)	(0.482)	(0.734)
CPI rate	-0.00617	0.000218	-0.00211	0.0139	0.0204**	0.0248	-0.00867
	(0.0175)	(0.00982)	(0.00947)	(0.0225)	(0.00985)	(0.0200)	(0.0212)
Constant	22.61***	19.06***	11.44**	23.62	11.36**	-14.19***	17.45**
	(8.402)	(5.626)	(5.428)	(21.30)	(5.270)	(4.966)	(7.124)
No. of observations	330	990	660	660	660	430	814
Adjusted R-squared	0.879	0.898	0.905	0.867	0.876	0.907	0.896
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster level	Bank	Bank	Bank	Bank	Bank	Bank	bank

Table 6: Robustness - Sample period and outliers

This table includes additional robustness checks for the difference-in-differences results. The sample period is 2003-2007. In the first column, observations from Belgian banks involved in mergers after the introduction of the NID are removed from the sample. In the second column I remove the Belgian banks above the 90th percentile in terms of the difference between equity ratio growth after and before the introduction of the NID. The third column excludes the control group banks below the 10th percentile in term of the difference in equity ratio growth before and after the introduction of the NID. The fourth column combines the restriction of Columns 2 and 3. The last column removes the year 2005 from the analysis. All regressions include bank fixed effects and the same set of control variables as used in the baseline setup in Table 2, Column 5. Standard errors are clustered at the bank level. ***, ** and * denote $p<0.01$, $p<0.05$ and $p<0.1$ respectively.

	(1)	(2)	(3)	(4)	(5)
	ln(ETA)	ln(ETA)	ln(ETA)	ln(ETA)	ln(ETA)
Treated x Post	0.145***	0.139***	0.186***	0.146***	0.187***
	(0.0446)	(0.0530)	(0.0541)	(0.0535)	(0.0638)
Post	0.0134	0.0161	0.0107	0.0136	0.0267
	(0.0164)	(0.0158)	(0.0185)	(0.0185)	(0.0256)
Total assets	-0.119***	-0.118***	-0.133***	-0.131***	-0.133***
	(0.0245)	(0.0259)	(0.0271)	(0.0266)	(0.0299)
Return on assets	-0.0572**	-0.0492*	-0.0511*	-0.0447	-0.0529
	(0.0252)	(0.0259)	(0.0267)	(0.0273)	(0.0349)
Loan Ratio	0.0225	-0.106	-0.00461	-0.0794	-0.0385
	(0.160)	(0.121)	(0.158)	(0.129)	(0.158)
Non-interest income share	0.165	0.152	0.0814	0.0611	0.114
	(0.161)	(0.177)	(0.182)	(0.190)	(0.205)
Nonperforming loans	-0.0275	0.0815	0.163	0.181	0.0666
	(0.252)	(0.319)	(0.399)	(0.423)	(0.380)
GDP per capita - growth	0.0240***	0.0230**	0.0316***	0.0300***	0.0217
	(0.00894)	(0.00896)	(0.00881)	(0.00911)	(0.0138)
ln(GDP per capita)	-1.880***	-1.745***	-1.931***	-1.793***	-1.982***
	(0.385)	(0.395)	(0.503)	(0.504)	(0.430)
CPI rate	0.00369	0.00874	0.000282	0.00723	-0.000581
	(0.00834)	(0.00804)	(0.0102)	(0.00913)	(0.00916)
Constant	21.46***	20.18***	22.12***	20.77***	22.64***
	(3.851)	(3.958)	(5.014)	(5.044)	(4.309)
No. of observations	656	640	605	585	528
R-squared	0.907	0.907	0.901	0.917	0.877
Bank FE	Yes	Yes	Yes	Yes	Yes
Cluster level	Bank	Bank	Bank	Bank	Bank

Appendix

Table A1: Country list

This table shows information for the corporate tax rate and the equity ratio for the matched countries included in the matched sample. For each country, the number of banks included in the analysis, the average equity ratio and the average tax rate over the sample period (2003-2007) are reported.

Country	No. of banks	Equity ratio	Effective tax rate
BELGIUM	33	6.96	18.3
DENMARK	1	15.86	25.28
FINLAND	1	4.87	27.63
FRANCE	1	4.69	30.12
GERMANY	6	6.55	40.85
GREECE	3	5.02	13.58
ITALY	53	8.04	36.68
NETHERLANDS	1	2.70	22.63
PORTUGAL	6	5.97	16.49
ROMANIA	3	17.84	21.37
SPAIN	18	6.26	23.50
UNITED KINGDOM	6	4.23	28.20

Table A2: Variable definitions

This table includes the definitions of the variables used throughout the paper. The first column shows the name of the variable as used throughout the paper, the second column shows the corresponding definition and the third column gives the source for the raw data used to construct the variable.

Variable	Description	Source
	Bank-specific variables	
Equity ratio	Total equity over total assets	Bankscope
Effective tax rate	Pre-tax profits minus profits over pre-tax profits	Bankscope
Total assets	Total assets (in millions of 2007 US dollars)	Bankscope
Loans	Total loans (in millions of 2007 US dollars)	Bankscope
Return on assets	Profits over total assets	Bankscope
nonperforming loans	Ratio of nonperforming loans over total loans	Bankscope
Non-interest income	Non-interest income over total income	Bankscope
Loan ratio	Total loans over total assets	Bankscope
sd(ROA)	Standard deviation of the return on assets over the past three years	Bankscope
Z-score	Ratio of equity plus return on assets over sd(ROA)	Bankscope
Equity	Total equity	Bankscope
Retained income share	Retained income over post-tax profit	Bankscope
Equity reserves	Retained earnings plus other equity reserves	Bankscope
Leverage	Average leverage (debt/total assets) of firms in a banks' loan portfolio	Belgian balance sheet central
Altman Z	Average Altman Z of firms in a banks' loan portfolio	Belgian balance sheet central
Interest burden	Average interest burden (interest paid over cash flows) of firms in a banks' loan portfolio	Belgian balance sheet central
Country-specific variables		
GDP per capita growth	Growth in gross domestic product per capita	World Development Indicators
CPI	consumer price index	World Development Indicators
GDP per capita	GDP per capita	World Development Indicators