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Horvath, B.L.

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By

Bálint Horváth

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TILBURG UNIVERSITY

The Impact of Taxation on Bank Leverage and Asset Risk

Bálint L. Horváth*

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Abstract

The tax-benefit of interest deductibility encourages debt financing, but regulatory and market constraints create dependency between bank leverage and risk. Using a large international sample of banks this paper estimates the short and long run effects of corporate income taxes (CIT) on bank capital structure and portfolio risk accounting for their simultaneous determination. A 10 percentage point increase in the statutory CIT rate is associated with an increase of 0.8-1.4 percentage points in bank leverage and a 2-7-percentage point reduction in the average risk-weight of assets. While the estimated overall effect of taxation on bank risk is modest, it induces significant portfolio reallocation toward less lending. These results suggest that any elimination of the tax-bias of debt may not bring the expected benefits for bank stability.

JEL Classification Numbers: G21; G28; G32; H25

Keywords: Bank leverage; Bank regulation; Bank risk; Corporate taxation; Debt-bias

*Tilburg University, Department of Economics. Email: b.l.horvath@uvt.nl. I am thankful to Harry Huizinga, Wolf Wagner, Olivier de Jonghe and Thorsten Koeppl and participants of a seminar at Tilburg University for helpful comments and suggestions.

1 Introduction

There is consensus among researchers that bank capital structure is an important determinant of financial stability as better capitalized banks tend to be more resilient. This realization motivates a large literature trying to understand the determinants of bank capital structure, one of which is corporate income taxation (CIT). In particular, taxation was identified as one of the possible sources that might have indirectly contributed to the financial crisis of 2007 and 2008 (De Mooij, 2012; Slemrod, 2009; Turner, 2010). Yet, there is scarce evidence on the effects of corporate income taxation on bank stability, with existing papers concentrating on the connection between taxes and leverage, but neglecting the consequences of taxation for bank portfolio risk. The aim of this paper is to fill this gap by measuring the effect of CIT on bank risk, taking into account that bank leverage and asset risk are intertwined.

The leverage-inducing effect of CIT has long been known and investigated for non-financial firms, but only recently has attention turned to the role of CIT in determining banks' capital structure (Keen and de Mooij, 2012; De Mooij et al., 2013; Gu et al., 2012; Hemmelgarn and Teichmann, 2013). The tax bias arises, because in most countries debt financing has a tax advantage through interest deductibility relative to equity financing. In the banking sector, however, this distortion interacts with limits on bank leverage forced upon banks by regulators, linking bank leverage and risk.

Banks constrained by risk-based capital requirements are likely to trade-off leverage and asset risk in order to comply with capital regulation. Typically, however, banks hold capital buffers, and the theoretical literature offers contradicting predictions on the relationship between leverage and risk when banks are not under regulatory pressure. Moral hazard, induced for instance by flat-rate deposit insurance and asymmetric information, can lead to excessive risk-taking in the form of both high asset risk and high leverage (Holmström and Tirole, 1997). This creates a potentially positive relationship between observed levels of leverage and asset risk. On the other hand, implicit and explicit costs associated with breaching capital requirements can give rise to precautionary buffer targeting, which re-introduces the trade-off created by capital regulation. Leverage risk and portfolio risk can also become substitutes if banks balance bankruptcy cost with other benefits of debt financing, such as the tax-shield (Orgler and Taggart, 1983).

Previous literature estimates the effect of corporate income tax rates on banks' capital structure, but neglects the potential endogeneity of bank risk. Disregarding the possibility that banks change asset risk in response to taxation might lead one to overestimate the negative effects of taxes on bank risk. To overcome this issue we estimate reduced form regressions (in both static and dynamic models) to measure the effect of CIT on bank leverage, asset risk and overall bank risk.

Using a data set that includes 17 003 banks from 71 countries and spans the years 1997-2011, we obtain the following main results. Consistent with earlier papers higher corporate income tax rates induce banks to choose higher leverage ratios. The long run marginal impact is 0.08-0.14, which is between the ranges previously found using bank level data (0.14-0.31 in Keen and de Mooij (2012) and De Mooij et al. (2013) and 0.1 in Hemmelgarn and Teichmann (2013)) and country level data (0.04-0.09 in De Mooij et al. (2013)).

We also find that banks located in countries with higher CIT hold lower risk-weighted assets (RWA) – conditional on a wide range of bank and country characteristics. A 10-percentage-point increase in CIT leads to a reduction of RWA relative to total assets of 2-7 percentage points. This impact cannot be fully attributed to risk-weight manipulation, since as we show, CIT also has a negative effect on the volume of relatively risky bank lending and a risk reducing effect on portfolio quality. Thus, the consequences of CIT should not solely be assessed on the basis of its leverage increasing effects, as it also leads to significant asset portfolio reallocation. We also provide evidence that the asset risk reducing effect of taxation is stronger in countries where regulators are more stringent and for banks that are more constrained by regulatory pressure to meet capital requirements.

Looking at the overall impact of taxation on bank stability, we find no evidence that corporate income taxation makes banks less safe. In fact, regressions on banks' Z score –a measure of the likelihood of bank failure– suggest a risk reducing effect of taxes, but the results are not robust. Overall, our results suggest that the elimination of the debt bias may not bring the expected benefits, since banks may substitute leverage risk for asset risk.

This paper bridges and extends two strands of literature. The first of these aims at quantifying the effect of CIT on bank capitalization. This literature is itself part of a larger research agenda, which seeks to understand whether banks have optimal capital ratios and if so, what their determinants are. Theoretical work includes Orgler and Taggart (1983), Myers and Rajan (1998), Calomiris and Kahn (1991), Diamond and Rajan (2000), and Allen et al. (2011). Empirical evidence of the existence of optimal capital structure is provided by Schaeck and Čihák (2012), Flannery and Rangan (2008), and Marcus (1983); and the literature has also converged to a set of factors that are reliable determinants of bank (and non-financial firm) leverage (c.f. Gropp and Heider, 2010; Frank and Goyal, 2009; Berger et al., 2008). While evidence on the tax-bias is abundant, most papers discard financial firms from the analysis (see e.g. the reviews of Graham, 2006; Auerbach, 2002), and thus there is scare evidence on the impact of CIT on bank capital structure. Keen and de Mooij (2012) find a long run CIT impact on bank leverage close to what the literature covering non-financial firms has found. Hemmelgarn and Teichmann (2013) look at how banks change their leverage, dividend policy and earnings management in reaction to tax rate changes and find a positive, but somewhat lower tax elasticity of leverage for banks. De Mooij et al. (2013) go one step further and estimate the effect of CIT on the likelihood of financial crises through increased leverage. Gu et al. (2012) concentrate on multinational banks' cross-boarder debt-shifting incentives. Building on Huizinga et al. (2008), who estimated similar effects using a sample of non-financial firms, they find that, beside local tax rates, home-host country tax rate differences induce banks to allocate more capital to subsidiaries where CIT rates are lower. A common feature of these papers is that they treat asset risk as an exogenous variable,[1] and little or no attention is paid to the simultaneous determination of asset risk and leverage. Our paper extends this literature by treating both leverage and risk as endogenous variables. Furthermore, we include a much richer set of control variables than these papers do.

A related strand of literature aims to understand how banks coordinate capital and risk adjustments and what role capital regulation plays in this relationship. Using a partial adjustment model with simultaneous equations for capital and risk adjustments, originally developed by Shrieves and Dahl (1992) and then applied by Jacques and Nigro (1997), Aggarwal and Jacques (2001), Rime (2001), Heid et al. (2004) and Jokipii and Milne (2011), this literature generally finds a positive relationship between the short run adjustments of capital and asset risk. We extend this literature by adding taxes to the determinants of target leverage and portfolio risk and, to the best of our knowledge, for the first time the simultaneous equations/partial adjustment model is applied on an international sample of banks.

Our paper is also related to the recent literature that tries to determine the most important factors of banks' RWA density (risk weighted assets to total assets). Le Leslé and Avramova (2012) list several bank and country level factors that can potentially influence RWA density. Mariathasan and Merrouche (2013) provide evidence that banks regulated under Basel II took advantage of advanced methods to calculate regulatory capital, which allowed them to lower their capitalization levels. This eventually led to an increased likelihood of failure during the financial crisis. We contribute to the scarce empirical evidence on RWA density determinants by including several factors in our regressions that can potentially be related to RWA density and have not yet been tested.

We proceed as follows. In section 2 we motivate the hypotheses of this paper and in

[1]Keen and de Mooij (2012) treat risk as an exogenous variable in their theoretical model, and as an endogenous explanatory variable in their empirical work, but they neglect the effects of CIT on bank risk.

section 3 we explain the applied econometric approach. In section 4 we describe the data used in the regressions. Section 5 presents the results of the regressions and section 6 discusses the results and concludes.

2 Hypotheses and theoretical framework

We use a simple model to show how bank capital regulation and corporate income taxation might interact. The key feature is that regulatory requirements are defined by leverage and a regulatory measure of bank risk in the spirit of the Basel accords. We do not explicitly solve banks' optimization problem, but the equations help spell out the hypotheses of this paper.

2.1 The interaction between capital regulation and taxation

There are two types of liabilities, equity capital K and debt D, and N types of assets, denoted by $A_i, i \in \{1 \dots N\}$. Each asset type's risk is measured by a (regulatory) risk weight ω_i. The following accounting identity must hold all time:

$$A = \sum_i A_i = K + D, \tag{1}$$

where A denotes total assets. The leverage ratio is then defined as $l = D/A$ and risk as $r = \sum_i \omega_i A_i / A$. The choice of risk measure is justified by its close correspondence to regulatory constraints. In the empirical part we also study alternative risk measures.

We assume that banks choose a target leverage ratio of the form

$$l^* = f(r, \tau, X), \tag{2}$$

where τ denotes the marginal corporate income tax rate and X is a vector of other capital structure determinants and bank characteristics. In a Modigliani-Miller world the level of

l is irrelevant. In reality firms (including banks) balance the costs and benefits associated with deviations from the MM world, such as agency problems, tax-bias and bankruptcy costs, which yields an intermediate level of optimal leverage. The vector X thus controls for differences in this trade-off. The expected effect of τ is positive, because of the tax-benefits of debt as a result of interest deductibility.

We assume that banks also have a target level of risk:

$$r^* = g(l, \tau, Y), \tag{3}$$

where Y is a set of bank characteristics that possibly overlap with X. Factors that can be related to risk taking include firm governance characteristics and ownership structure (by influencing the type and severity of agency problems within firms), size (through too-big-to-fail subsidies), business mix, and the regulatory environment. Note, that we allow for risk to possibly depend on taxes, although we are not aware of studies that look into the effects of taxes on bank risk taking. The main channel taxes are expected to influence bank risk taking works through banks' profitability. The literature referred to in the introduction establishes a link between risk taking and bank charter value due to moral hazard. Since corporate income taxes reduce profitability, banks might respond by taking more overall risk, possibly by increasing asset risk r.

In (2) and (3) leverage and risk decisions are interrelated either directly, or indirectly through common elements in X and Y. Capital regulation imposes a further layer of restrictions on bank leverage and risk. In particular, consider the following constraint:

$$k < \frac{K}{\sum_i \omega_i A_i} = \frac{K}{\sum A_i} \Big/ \frac{\sum_i \omega_i A_i}{\sum A_i} = \frac{1-l}{r}, \tag{4}$$

where k is the minimum capital adequacy requirement. This form of a capital constraint is similar to that implemented under the Basel accords. Under Basel I and the basic forms of Basel II banks are required to hold at least 8% eligible capital relative to risk weighted assets.[2] Notice, that a binding capital requirement constraint implies that leverage l and asset risk r become substitutes in the sense that banks can choose higher leverage levels by lowering asset risk.

Motivated by the corporate finance literature on taxes, we hypothesize that banks choose higher levels of leverage in countries where CIT rates are higher, which is reflected in the total effect of taxes on leverage (including the indirect effect through asset risk): $\mathrm{d}l^*/\mathrm{d}\tau > 0$. Next, we hypothesize that banks reduce asset risk in order to alleviate regulatory pressure on their capitalization: $\mathrm{d}r^*/\mathrm{d}\tau < 0$.

The constraint (4) may not hold at all times. Indeed, the buffer theory of bank capital predicts that banks hold target buffer levels above the regulatory minimum in order to minimize the risk of falling below the regulatory requirements. Empirical evidence for banks' capital buffer targeting is provided by –among others– Jokipii and Milne (2008). Thus, even though the regulatory constraint may not bind for certain banks, they may very well target regulatory buffers, which can re-introduce the trade-off between bank leverage and asset risk. We hypothesize that the tax impact on target capital buffers is relatively small, so that the previous hypotheses hold for unconstrained banks as well.

To see whether capital-tight or capital-abundant banks respond more to taxes consider a bank that is constrained by capital regulation (equation 4) and one, which is not. To increase leverage by one percent, the constrained bank has to cut asset risk by $1/k$ (=$\mathrm{d}r/\mathrm{d}r$) percent (assuming prohibitively high non-compliance costs). However, choosing a different-from-target asset portfolio involves costs and thus a bank balances these costs with the tax-benefits of leverage. Since an unconstrained bank does not necessarily have to adjust its asset portfolio in order to maintain a sufficient level of regulatory capital, we expect

[2] We do not distinguish between different forms of eligible regulatory capital. Under Basel I and II Tier I capital comprises mostly common equity, while Tier II capital denotes various forms of hybrid capital elements, such as subordinated debt. Hybrid capital forms have the benefit that interest repayments on them are generally interest deductible, while they qualify as regulatory capital – up to a certain limit. As a result, as Keen and de Mooij (2012) show, banks have a tendency to choose the maximum amount of hybrid capital funding up to the allowed limit to meet regulatory requirements, the level of which is not effected by CIT. Therefore, abstracting from this capital element has little bearing on the estimated tax effects on bank capital structure.

that better capitalized banks are more tax responsive.

2.2 Partial adjustment

It is common in the literature to assume that capital structure adjustment is not immediate (c.f. Gropp and Heider, 2010; Berger et al., 2008). To allow for sluggish adjustment we build on Shrieves and Dahl (1992), who assume that observed changes in capital and risk have two components, discretionary adjustment and exogenous shocks. Discretionary changes are the result of banks' optimal capital and risk decisions, while exogenous shocks to risk might reflect unexpected changes in the business cycles or in case of capital, unexpected loan losses.

$$\Delta l_{ijt} = \Delta l^b_{ijt} + u_{ijt} \tag{5}$$

$$\Delta r_{ijt} = \Delta r^b_{ijt} + v_{ijt}. \tag{6}$$

The econometrician observes Δl_{ijt} and Δr_{ijt}, but banks' planned leverage and risk adjustment Δl^b_{ijt} and Δr^b_{ijt}, and the exogenous shocks u_{ijt} and v_{ijt} are unobservable. Next, Shrieves and Dahl (1992) and the subsequent literature assume that banks have target leverage and risk levels, which are denoted l^* and r^*, respectively. The final assumption of the model is that banks do not immediately adjust to their target levels after either leverage and/or risk was hit by a shock in the previous period. Instead, it is assumed that the speed of adjustment is proportional to the distance from the target level:

$$\Delta l^b_{ijt} = \psi(l^*_{ijt} - l_{ijt-1}) \tag{7}$$

$$\Delta r^b_{ijt} = \chi(r^*_{ijt} - r_{ijt-1}). \tag{8}$$

In the last part of the paper we attempt to disentangle the short run effect of taxation from its long run impact. The channels outlined above are expected to operate mainly in the long run (they relate to equilibrium quantities), but CIT can have potentially different short run effects. For example, an increase in tax rates could damage portfolio quality in the short run by lowering firms' ability to service debt to banks, while it might take time until banks adjust to a lower equilibrium asset risk level. Moral hazard can also give rise to a positive relationship between CIT and bank risk in the short run. If CIT erodes charter value by lowering the discounted value of future profits banks might choose excessively risky decisions to gamble to recapitalize. If the gamble pays off, banks might adjust toward a safer risk profile in the long run, if not, they either go bankrupt or have to recapitalize by issuing new equity. It is also possible, that the long run effects of taxation through moral hazard are attenuated by an offsetting change in market structure, whereby some banks leave the market, thus restoring charter value. The last hypothesis is thus that the impact of CIT in the short run is potentially different from that on equilibrium levels.

3 Econometric approach

From the previous discussion it follows that equilibrium leverage and asset risk are jointly determined. Instead of attempting to estimate the structural equations (2) and (3) we estimate reduced form regressions and measure the overall effect of taxes on leverage and asset risk.

We start the analysis with estimating static regressions of the form:

$$\overline{y}_{ij} = \alpha + \gamma \overline{CIT}_i + \delta \overline{X}_{ij} + \lambda \overline{Y}_i + \varepsilon_{ij}, \tag{9}$$

where y_{ijt} is either leverage or one of the risk measures of bank j in country i in year t, CIT_{it} is the statutory corporate income tax rate, X_{ijt} and Y_{it} are collections of bank and country level control variables, respectively, η_t and μ_{ij} are time and bank effects, and upper bars denote time-averaged variables. The focus of this paper is the coefficient γ, the reduced form marginal impact of CIT on equilibrium leverage/risk. We estimate equation (9) with simple OLS.

Next, following the literature on bank capital structure we estimate dynamic versions of (9), which allows for sluggish adjustment of the dependent variables. Inserting the equations for banks' planned adjustment (equations (7) and (8)) into the observed leverage and risk changes (equations (5) and (6)) and subsequently replacing the target leverage and risk levels, l^*_{ijt} and r^*_{ijt}, with the linearized versions of (2) and (3), one obtains after rearrangement:

$$y_{ijt} = \alpha + \beta y_{ijt-1} + \gamma CIT_{it} + \delta X_{ijt} + \lambda Y_{it} + \eta_t + \mu_{ij} + \varepsilon_{ijt}, \quad (10)$$

where ε_{ijt} is a potentially serially correlated idiosyncratic error term. The within estimator yields a biased estimator of (10), therefore we employ the system-GMM estimator developed by Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998). This estimator eliminates bank fixed effects through first differencing, while the resulting endogeneity due to differencing is resolved by instrumenting with lags. The advantage of the GMM estimator is that it exploits both the time and cross-sectional variations of the data, while still controlling for unobserved time-invariant heterogeneity. We employ the two-step GMM estimator to allow for a non-spherical error covariance structure and we calculate standard errors clustered at the country level. Furthermore, we also apply the finite sample correction to the two-step covariance matrix derived by Windmeijer (2005).

Specification (10) assumes that the target level of leverage (risk) does not depend on the contemporaneous adjustment of risk (leverage). In order to relax this assumption we modify (10) in the spirit of Shrieves and Dahl (1992) and subsequent literature:

$$\Delta l_{ijt} = a_1 l_{ijt-1} + b_1(1 + c_1 B^H_{it})\Delta r_{ijt} + d_1 CIT_{it} + e_1 X_{ijt} + f_1 Y_{it} + \eta_t + \upsilon_{ijt} \quad (11)$$

$$\Delta r_{ijt} = a_2 r_{ijt-1} + b_2(1 + c_2 B^H_{it})\Delta l_{ijt} + d_2 CIT_{it} + e_2 X_{ijt} + f_2 Y_{it} + \eta_t + \zeta_{ijt}, \quad (12)$$

where B^H_{it} is a dummy variable indicating larger-than-median regulatory capital buffers. Evidence suggests (Heid et al., 2004; Jokipii and Milne, 2011) that banks with different amounts of regulatory capital buffer coordinate the leverage-risk adjustment differently, B_{it}^{H} captures this effect. This specification also includes the contemporaneous adjustment terms Δl_{ijt} and Δr_{ijt} to account for the joint determination of leverage and asset risk. We estimate (11) and (12) as a system of simultaneous equations using 3SLS (instrumenting is required because of the simultaneity of the adjustment terms).

4 Data

We have an unbalanced dataset spanning the period 1997-2011, and covering 17 003 banks from 71 countries. We collect bank balance sheet data from Bankscope of Bureau van Dijk. This database contains balance sheet and income statement data from annual reports. We restrict the database to commercial banks, saving banks, and cooperative banks and exclude other forms of financial institutions (investment banks, mortgage banks, etc.). Next, we restrict the sample to unconsolidated balance sheet data. This reflects that corporate income taxes are country specific, while consolidated accounting data are often multinational. To reduce the bias due to misreporting and outliers we winsorize all bank level variables at the 1% and 99% levels. Additionally, we remove all banks from the database with negative equity, as these banks might exhibit exceptional balance sheet ratios. This leaves us with 148 608 bank-year observations, but due to limitations of the Bankscope database the sample size drops to 106 688 bank-year observations in the RWA density regressions, and to 103 624 bank-year observations in the regressions on the share of non-performing loans. About two thirds of the banks in our sample are located in the United States, which potentially has a sample bias effect on our results. To avoid this, we also report the main results using a restricted sample excluding US banks.

Table 1 shows summary statistics for all variables. The main dependent variables are the *Leverage* ratio, which is defined as liabilities over total assets and *RWA* density, defined as risk weighted assets to total assets. Additionally, we replace *RWA* with two alternative risk measures *Loans* (relative to total assets); and *NPL*, the natural logarithm of the share of non-performing loans to total loans.[3] These variables are closely related to bank asset risk. While *Loans* measures banks' exposure to risky assets relative to other, less risky assets, such as government bonds, *NPL* is a measure of the quality of banks' loan portfolios. Table 1 shows that *Leverage* has a mean of 0.89. Mean *RWA* density is 0.68, close to the mean of *Loans* at 0.62. The close association between RWA density and the loan ratio is shown by the high correlation between them (0.75 as seen in Table 2). The share of non-performing loans (before taking logarithm) is close to 3% with a standard deviation of 0.04, which illustrates that it is indeed a skewed variable (as it is always nonnegative). We assess the overall effects of corporate income taxation on bank risk using the natural logarithm of Z score. Z score measures the losses required to entirely wipe out a bank's equity capital and is defined as $Z\,score = \log[(K/A + ROA)\,/\sigma(ROA)]$, where $\sigma(ROA)$ is the standard deviation of return on assets. *Z score* is thus a measure of distance to default, higher values reflecting safer banks. Log is taken of Z score because it has a highly skewed distribution.

Table 2 and Table 3 reveal interesting correlations between the main variables. *CIT* and *Leverage* are positively and significantly correlated, both in levels and first differences. On the other hand, *CIT* is significantly and negatively correlated with all three risk variables in levels, which is consistent with the hypothesis of a substitution effect between equilibrium leverage and risk. However, correlation between the first differences of *CIT* and *RWA* and *Loans* are positive and significant, while in case of *NPL* it is insignificant. A possible explanation for this difference can be that the the short run impact of *CIT* is different from its long run impact. We will investigate this later.

The main sources of the statutory corporate income tax rates are the OECD database and, in case of non-OECD countries, the KPMG Corporate and Indirect Tax Surveys 2007, 2010 and 2011, which cover the period between 1993 and 2011. The average tax rate is 38.6%. This relatively high figure is due to our sample containing a large number of banks

[3] We took the logarithm of the share of non-performing loans, because it is has a highly skewed distribution.

located in the United States, Germany and Japan, all of which have high CIT rates (on average 39.3%, 39.5% and 33.3%, respectively).

We control for a wide range of bank and country level factors related to bank leverage and assets risk. Since we perform reduced form estimations, we include all control variables in both the leverage and risk equations. Bank size is commonly found to be positively related to leverage, which is explained by large banks' better risk diversification possibilities, better investment opportunities and access to debt capital. *Size* is taken to be the natural logarithm of the book value of total assets and to allow for a non-linear effect we also include the square of this variable. We also control for bank profitability by including two variables, *net interest margin*s and the return on average assets (*ROA*): on the one hand firms may choose riskier asset portfolios in return for higher expected returns, on the other hand positive retained earnings improve banks' capitalization keeping other factors constant. *Fee income*, defined as non-interest income over total operating income, and *Wholesale funding*, measured by the ratio of non-deposit funding to total short term funding, control for income diversification and access to whole-sale funding. Both factors are shown to change the risk/return trade-off that banks face by Demirgüç-Kunt and Huizinga (2010). Following the literature on capital and risk adjustment we include *Loan losses* relative to total assets to control for the short term changes in risk-weighted assets due to contemporaneous losses. DeAngelo and Masulis (1980) show that non-debt tax shields, such as depreciation and investment tax credits, can crowd out the tax benefits of debt. To control for differences in access to non-debt tax shields we include *Non-interest expenses* relative to total assets, a proxy also used by Gu et al. (2012). As mentioned in the introduction cross-border differences in CIT are also important determinants of the capital structure of multinational banks. To control for cross-border debt-shifting we include *Foreign subsidiary*, a dummy variable indicating a share of foreign ownership of 51% at least. Overall about 3% of the observations are from foreign subsidiaries. The final bank level control variable is *Market share*, the share of total assets relative to nationwide total bank assets, a proxy for market power.

In addition to the bank level control variables we also add country level macroeconomic controls. *RGDP growth* controls for business cycle fluctuations, while *GDP per capita*, calculated on a PPP basis, controls for differences in the economic development between countries, which might be correlated with financial and capital market development. The consumer price index (*CPI*) serves as a proxy for expected inflation. The real value of tax deductions depends on expected inflation, thus it is an important control variable (also confirmed by Frank and Goyal, 2009). *Government debt to GDP* serves to control for "financial repression" and/or banks' incentives to load on highly indebted governments' debt. Under Basel I and II sovereign debt is treated as riskless (in case of OECD countries) or low risk assets and fetch low risk weights. The last macroeconomic control variable is the nominal *Exchange rate change*, which has been shown to affect portfolio risk (Bock and Demyanets, 2012). A large nominal exchange rate depreciation might reduce borrowers' ability to service debt denominated in foreign currencies, which –ceteris paribus– worsens portfolio quality. On the contrary, depreciation might be beneficial, if this strengthens international competitiveness and improves corporate profits. *RGDP growth*, *GDP per capita*, *Government debt/GDP*, *CPI* and *Exchange rate change* figures were taken form the World Economic Outlook database. *Aggregate credit* controls for loan demand, which we calculate for each bank i in a given year as the sum of gross loans of all banks in the country of bank i less the stock of gross loans of bank i, normalized by the sum of total assets of all banks in the given country. It is common that corporate income taxes are the same for financial and non-financial companies, therefore taxes might be correlated with loan demand (through the same tax-shield effect or by influencing firm profitability) as well as bank leverage and risk. Since loans are generally riskier then other risky assets, such as government bonds, an increase in loan demand may lead to higher RWA density through an increased share of loans in total assets.

Next, we control for the regulatory environment by including minimum *Capital require-*

ments and two other indicators from Barth et al. (2001). The first, *Capital stringency* is a measure of regulatory oversight of how banks calculate capital, which ranges between 0 and 9, higher values indicating more stringency. *Activity restrictions* is a variable that measures regulatory restrictions on certain bank activities, such as securities market, insurance, real estate activities and the ownership of non-financial firms, on a scale between 4 and 16, with higher values indicating more restrictions. These regulatory controls are commonly used in the bank risk taking and capital regulation literature (see Laeven and Levine, 2009, for example). Bank regulation data are obtained from the Worldbank's Bank Regulation and Supervision Survey database. The survey comprises four waves, 2001, 2003, and 2007, 2011 and we replace missing values of interim years by the values of subsequent years (so for instance observations of 2009 are taken from the last wave). In some specifications we include a dummy variable *Buffer dummy*, which takes the value of 1 if a bank has on average over the sample period a capital buffer larger than the median buffer. We also include the dummy variable *Basel II* indicating whether in a given year and a given country the Basel II guidelines were implemented and effective. This dummy serves to control for the possibility that Basel II allows for a more lenient way of calculating regulatory capital. Under Basel II banks can opt for internal models to determine risk weights, which opens the door for regulatory arbitrage and risk-weight manipulation through model optimization (Mariathasan and Merrouche, 2013). The dummy is constructed from data from the BIS progress reports on the implementation of the Basel regulatory framework.[4] Finally, we control for shareholder protection with *Creditor rights*, an index of statutory rights of shareholders from Djankov et al. (2007). The index ranges from zero to six and higher values indicate more shareholder protection.

[4]The first year in which this variable is nonzero is 2007, when all EU Member States introduced the new regulation, along with few other countries. Some countries, however, waited with the implementation, the US for instance was a slow mover with an adoption year of 2009. By 2011 forty-four countries had adopted the Basel II rules in our sample.

5 Results

In this section we present the results of the regressions laid out above. We start with single equation regressions of leverage, RWA-to-assets, loans-to-assets and non-performing loans. Then we investigate whether taxation and bank regulation interact. Following this, we estimate the leverage and risk equations as a simultaneous system of equations, and finally, we assess the overall impact of taxation on bank stability.

5.1 Leverage regressions

The left panel of Table 4 shows the baseline regressions of bank leverage. In column (1) we report the between estimates, using the full sample. The estimate of the *CIT* coefficient is significant, but at 0.08 it is considerably smaller than what earlier literature found using similar bank level data (e.g. Keen and de Mooij (2012) and De Mooij et al. (2013)). These papers find long run tax effects on leverage in the range of 0.14-0.31. In unreported regressions, which include only the control variables used by the mentioned studies (*Size*, $Size^2$, *ROA*, *CPI*, *RGDP growth*), we find that the difference comes mostly from the second effect. For example, dropping the dummy *Basel II* increases the coefficient estimate of CIT from 0.08 to 0.18. However, dropping any other further control variable does not change this coefficient estimate by more than 0.02.

The control variables have generally the signs found in other studies: *Size* is positively and significantly related to leverage in a non-linear way. *Net interest margin* is also significant and obtains a negative coefficient. Similarly, *ROA* obtains a negative, but insignificant coefficient. Thus, banks seem to use retained earnings to recapitalize. The risk characteristics proxies, *Fee income* and *Wholesale funding*, are negatively related to leverage, which is consistent with a substitution effect between various risk types. *Loan losses* are negatively related to leverage, indicating that banks with higher expected losses shield themselves with larger capital buffers, although the coefficient is insignificant. The non-debt tax-credit proxy, *Non-interest expenses*, has a significant, negative coefficient, like in Gu et al. (2012). *Foreign subsidiary* obtains a negative, significant coefficient, which suggests that the overall effect of cross-border tax differences is such that it shifts debt away from host to home countries. Finally, *Market share* is positively related to leverage, which may be because banks can borrow against the net present value of their monopoly rents. At the country level higher *capital requirements* and *activity restrictions* reduce, stronger *creditor rights* enhance debt financing, as expected. *Basel II*, *GDP growth* and *GDP per capita* enter with negative and significant coefficients, while *Aggregate credit* enters with a positive sign.

In column (2) we follow the literature on bank capital structure, and estimate a dynamic panel model (equation (10) in section 3) with the system GMM estimator. The estimated short run impact is 0.03, significant at 10%, which is about third of what Keen and de Mooij (2012) find. They, however, find a slower adjustment speed than we do: our estimate of the coefficient of the lagged dependent variable is 0.58, significant at 1 %. These coefficients combine into a long run marginal effect of 0.08 ($= \gamma/(1-\beta) = 0.03/(1-0.58)$), which is very close to the long run estimate using the between estimator in column (1). This estimate, however, loses significance, which might be partly due to the approximations needed to calculate the standard error of this non-linear function. A 10% increase in the statutory income tax rate is thus expected to increase bank leverage by about 0.8 percentage points.

In columns (3) and (4) we present additional robustness checks using the between estimator. Restricting the sample to the years prior to the crisis (up to 2006) yields a significant estimate of the long run marginal effect of CIT, which is 0.14, about twice as large as our baseline between estimate. This is perhaps not surprising, since one could expect other factors than taxation to be more relevant for the level of bank capitalization during distressed periods. If we exclude US banks we find a significant estimate close to our baseline between estimate.

5.2 RWA density regressions

The right panel of Table 4 shows the results of regressions on risk weighted assets to total assets. The regressions are analogous to the leverage regressions in columns (1)-(4). In column (5) we present the results of the between estimation, using long run averages. Consistent with the buffer theory of bank capital, we find that CIT has a negative coefficient of -0.21, significant at the 1% level. A 10 percentage point hike in tax rates has an expected long run effect of about two percentage points, which seems small compared to the average level of 67%, but it could have significant effects on the real economy through loan supply.

Next, in column (6) we allow for sluggish adjustment using the system GMM estimator, also controlling for time and bank fixed effects. Along with other time-invariant bank characteristics, bank fixed effects should control for corporate governance performance and ownership structure, which have been shown to be related to bank risk-taking (Laeven and Levine, 2009). To estimate this regression we restricted the sample to exclude years up to 2003, because almost all RWA observations prior to 2004 were submitted by US banks. The rate of adjustment is slow, banks close only about 15% of the gap between target and actual RWA density per year. The short run impact of *CIT* is -0.1, which is significant at 5%. This translates into an expected long run marginal effect of -0.69, significant at 10%, about three times the between estimate. Interestingly, when we exclude the crisis years we obtain a long run impact very close to this number using long run averages and OLS in column (7). However, dropping US banks (but retaining the full length of the sample period) gives a coefficient estimate which, at -0.16, is smaller than that of the baseline between estimator and not significant. Overall, Table 4 suggests that banks reduce asset risk in response to taxation.

Most control variables obtain the expected signs. *Size* is positively associated with risk, which might reflect moral hazard due to too-big-to-fail benefits; but there are diminishing returns as suggested by the significant, negative coefficient of the quadratic term. *Net* *interest margin* has a positive coefficient in all but the last column, all significant at 1%. This might be because banks charge higher interest rates for more risky loans. *ROA*, on the other hand has a negative coefficient in all regressions, except in the between regression excluding US banks. The negative relationship could be the result of moral hazard, to the extent that smaller profitability reduces charter value. *Fee income* is negatively associated with *RWA*, perhaps signaling that more income diversification is accompanied by more risk taking (consistent with mean/variance optimization).

The negative and significant coefficient of *Basel II* in all specifications is evidence of banks reducing risk weights through the adoption of risk models allowed by Basel II. Exchange rate deterioration (appreciation) has a significant, positive (negative) impact on bank risk, possibly due to a lower income to debt service ratio for borrowers indebted in foreign currency. Loan demand is positively associated with RWA density, probably as a result of increased lending relative to investing in low-risk securities. Higher growth, on the other hand, seems to improve bank portfolio quality, reducing RWA density, while more developed countries' banking systems can contribute to the economy with a riskier bank portfolio, perhaps due to better institutions and/or more available or better collateral. This is reinforced by the positive coefficient of *Creditor rights* in the baseline between regression, although excluding crisis years changes the sign of this coefficient. The positive coefficient of *Net interest margin* may reflect that more risky portfolios are compensated with higher margins. Contrary to our expectations, government indebtedness enters with a positive sign in the baseline between and GMM regressions. This could be, however, explained if government securities improve the efficiency of financial intermediation by providing safe collateral. Finally, the regulatory environment proxies do not seem to have robust effects on RWA density in our sample.

5.3 Loan-to-assets regressions

Table 5 presents single equation regression results on alternative measures of bank portfolio risk: the size of banks' loan portfolio and the ratio of non-performing loans to total loans, measuring portfolio quality.

We start with loans to assets in Table 5. The baseline OLS regression on long run averages (column (1)) shows that CIT is negatively associated with the share of lending in total assets. *CIT* has a long run marginal impact of -0.23, which is significant at the 1% level. Most coefficients have the same signs as those in the corresponding regression on risk weighted assets, which is not surprising given the high correlation between the two variables. There are differences, however. *Basel II* is not significant, and has a positive coefficient now, which is consistent with banks having achieved a reduction in risk weighted assets by lowering risk weights, and not by cutting lending. Another difference is in the coefficient estimates of loan demand (*Aggregate credit*), yielding consistently higher estimates in the loan regressions, reflecting a closer association between the two variables. The loan-to-assets ratio is negatively related to government indebtedness, which is expected, if there is regulatory/government pressure on banks to absorb government bonds. *Capital requirements* also obtain a negative coefficient in column (1), amplifying the previous effect: banks might adjust to meet higher regulatory capital requirements by buying more low risk assets and simultaneously reducing lending relative to total assets.

Returning to the effects of taxes, in column (2) the dynamic model gives a qualitatively similar result to the between regression, with a short run marginal impact of -0.07, which is significant at 10% and a long run impact of -0.9, which is not significant. Finally, the negative relationship between CIT rates and the loan-to-asset ratio is robust to excluding crisis years or US based banks, as shown in columns (3) and (4).

5.4 NPL regressions

Columns (5)-(8) of Table 5 report results of regressions on portfolio quality. The dependent variable is the log of the share of non-performing loans to total loans. Column (5) presents OLS estimates on the long run averages. *CIT* is estimated to have a long run marginal effect of -5.84, significant at 1%. The dynamic regression in column (6) produces a short run marginal impact of -1.49, significant at 1% and a long run marginal effect of -4.43, significant at 10%. The robustness checks in columns (7) and (8) yield ambivalent results. Using the pre-crisis sample only we find a long run impact of -7.68, significant at 1%. If we exclude US banks, on the other hand, we obtain a positive, but insignificant coefficient. Overall, these regressions imply, that *CIT* has a sizable impact on bank portfolio quality. A 10-percentage-point increase in *CIT* is expected to reduce the stock of non-performing loans relative to total assets by 44-77%, which amounts to a change of 0.27-0.45 standard deviations.

Among the control variables that obtain significant and robust coefficients *ROA* has a negative sign, perhaps because more nonperforming loans erode profits. *Loan loss* provisions obtain a positive coefficient as expected, while *Foreign subsidiaries* tend to have better portfolio quality in our sample. *Market share* and *Aggregate credit* have positive and significant coefficients, which is suggestive of looser lending standards when loan volume is high. *Basel II* picks up positive coefficients, except for the dynamic model, where it is insignificant, which may be because lower risk weights attained under the Basel II framework allowed banks to increase risk taking. As expected, real GDP growth facilitates debt repayment and improves bank portfolio quality, while a nominal exchange rate depreciation is, on average, expected to increase the share of non-performing loans, which thus seems to dominate the positive effects of larger corporate profits as a result of the depreciation.

5.5 The effect of regulation

Looking at the results of the previous sections the question arises to what extent the observed effects are attributable to bank regulation. In this section we aim to provide answer to that by investigating whether banks react differently if 1) they hold lower levels of regulatory capital buffers and 2) if they are subject to stricter regulatory supervision. Our approach is to include the interaction terms *CIT * Buffer dummy* and *CIT * Regulatory stringency*. Our expectations *a priori* are that especially capital abundant banks increase leverage in response to higher tax rates and stricter regulators force banks to reduce asset riskiness if they wish to increase leverage. The former effect is expected, since banks with higher regulatory capital buffer targets have more room to increase leverage without changing their asset allocations and while still complying with capital standards. Thus, to the extent that deviating from asset risk targets is costly, we expect these banks to be more responsive.

Table 6 shows the results of regressions with the interaction terms included. In column (1) the dependent variable is *Leverage*. Using the between effects estimator we find a CIT coefficient of 0.05 for banks with low excess regulatory capital, which is significant at the 1% level. This is smaller than the baseline estimate in column (1) of Table 4. Next, the dummy variable *Buffer dummy* obtains a significant, negative coefficient, reflecting that better capitalized banks have lower leverage. The interaction term is also significant and has a coefficient of 0.23. Thus well-capitalized banks seem to respond even more to taxation with an estimated long run impact of 0.28 (= 0.05 + 0.23) on leverage.

The RWA regression shows mirroring results. The CIT coefficient is significantly negative at -0.13, about half the value of the baseline estimate in column (5) of Table 4. Now, however, the capitalization dummy is insignificant (although positive, as expected). Not so the interaction term, which obtains a negative and significant coefficient of -0.25, bringing the overall effect of CIT for capital abundant banks to -0.38. This evidence is consistent with better capitalized banks having more leeway to increase leverage as a response to higher corporate tax rates and simultaneously reduce asset risk to maintain a targeted regulatory capital buffer. Furthermore, as expected, capital-tight banks seem to reduce asset risk relative to a unit change in leverage more than capital abundant banks: the former adjust leverage and risk at a ratio of 2.5:1 (= 0.13/0.05), while this is 1.36:1 (= 0.38/0.28) for the latter.

Next, in columns (3) and (4) we add the interaction term between *CIT* and *Regulatory stringency*. In the leverage regression (column (3)) *CIT* has a positive and significant coefficient, while the interaction term is negative and also significant. The estimated tax effect for a bank located in a country with average regulatory stringency is 0.08 (=0.24 - 0.03*5.3, see the descriptive statistics in Table 1), close to the baseline estimate without interactions (regression 1, Table 4). In the RWA regression the standalone CIT variable has a coefficient of 0.9, while the interaction term is negative (-0.21), with both coefficients estimated to be significant. This means that banks located in the least stringent regulatory environments are found to increase RWA in response to taxes, while banks located in countries with a *Regulatory stringency* index larger than 4.57 (=0.96/0.21) reduce asset risk. These results suggest that more stringent regulation reduces banks' incentives (or opportunity) to increase leverage in response to higher taxes.[5] At the same time, banks seem to be forced to cut back on asset risk more aggressively in more stringent regulatory environments, perhaps in order to be able increase leverage.

Overall, Table 6 gives some support to the hypothesis that banks trade off leverage against asset risk because of capital regulation.

[5]Nonetheless, for almost all banks the estimated CIT impact on leverage is positive. The marginal impact of *CIT* on leverage is zero when *Regulatory stringency* is equal to 8.29 = 0.237/0.0286. We have only five observations with *Regulatory stringency* larger than 8.

5.6 Dynamic simultaneous equations models

The aim of this section is to estimate the leverage and risk equations in a simultaneous equation system and obtain a more efficient estimate of the long run effects of CIT.[6]

Table 7 presents the results of the simultaneous equations regressions. Our baseline specification is regression (1). In the leverage regression the lag of leverage obtains a coefficient of -0.34, which yields a somewhat slower speed of adjustment than the single equation GMM estimate of regression (2) in Table 4. Similarly, the speed of adjustment of RWA density in the 3SLS model is also smaller (0.10) than the single equation GMM estimate of regression (6) in Table 4 ($1 - 0.85 = 0.15$).

Next, the long run marginal CIT effect on leverage is 0.09, significant at 5%, which is slightly higher than the OLS regression on time averaged variables (regression 1, Table 4). We find a bigger difference between the single equation and 3SLS regression estimates on *RWA*, as in the latter the long run impact of CIT is significantly larger in absolute terms at -1.7 than either the OLS or GMM estimate at -0.21 and -0.69 (regressions (5) and (6) in Table 4), respectively. Thus, while we estimate the CIT elasticity of leverage with a fair amount of precision, there is some uncertainty about the precise magnitude of the risk impact. Nonetheless, the tax coefficient consistently appears with a negative sign in the portfolio risk regressions.

Turning to contemporaneous adjustments in risk and leverage, we start with capital constrained banks. Banks respond to a contemporary change in *RWA* by increasing leverage by a factor of 0.06. Although statistically significant, this is a small response in economic terms. On the other hand, for a bank with smaller-than-median capital buffer an increase in leverage is associated with a more than 5-fold decrease in portfolio risk. Next, looking at the interaction term with *Buffer dummy*, the leverage response becomes somewhat larger

[6]Beside the reported dynamic regressions we also estimated a static system of seemingly unrelated equations of the form $y_{ijt} = \alpha + \gamma CIT_{it} + \delta X_{ijt} + \lambda Y_{it} + \eta_t + \varepsilon_{ijt}$, where the dependent variables are leverage and RWA-to-assets. The long run CIT effects were close to those obtained from the dynamic model, therefore we only present the latter.

(0.06 + 0.13 = 0.19), but still small. At the same time, the risk response also shrinks and turns even positive ($-5.38 + 6.0 = 0.62$). Overall, the coordination between asset risk and leverage adjustment is quantitatively not very important, except for banks with small capital buffers, which adjust *RWA* in response to changes in leverage to maintain regulatory compliance.

Up until now we maintained the assumption usually made in the partial adjustment literature, that the speed of adjustment is proportional to the difference from the target level, and that the target is a function of various explanatory variables. These assumptions link the short and long run effects of explanatory variables: an exogenous increase in *CIT* is assumed to trigger a monotonous response. In regression (2) we allow for *CIT* to have different short and long run impacts by estimating a modified version of regression (1), where we replace *CIT* with the first difference and the first lag of CIT rates (*D.CIT* and *L.CIT*, respectively). The first lag of *CIT* enters with the usual signs: positively in the leverage regression and negatively in the risk regression, with both coefficients significant at the 5% and 1% levels, respectively. The long run impacts are not far from the previous estimates, 0.07 and -2.01 in the leverage and risk regressions, respectively. Interestingly, *D.CIT* enters both regressions with positive coefficients. This variable measures the immediate impact of taxes. Thus, while CIT has a negative long run effect on RWA-to-assets, its immediate effect is positive, which is consistent with the moral hazard channel being dominant on the short run or an immediate deterioration (improvement) in loan portfolio quality when tax rates are increased (reduced).

5.7 Z score regressions

In this section we assess how CIT impacts overall bank stability. To this end, we first regress *Z score* on *CIT* and the same control variables as before except that we exclude *ROA* as it is directly related to *Z score*.[7] Table 8 reports the results. In column (1) using

[7] In unreported regressions we find that the inclusion of *ROA* yields similar results to the reported ones.

the between estimator, we find a significantly positive coefficient estimate of 1.3, which is about the same as the standard deviation of the log of banks' Z score. Thus, a 10% pp tax increase is associated with an increase of about one tenth of the standard deviation of log-Z score – a modest change by any account. This suggests that the portfolio risk reduction more than offsets the risk increasing effect of leverage. Since regulation alone does not justify a full, or more than full offset, it seems likely that taxation has an effect on bank risk through other channels as well. The GMM regression in column (2) gives further evidence that the quantitative impact of taxation on banks' Z score is small, as the coefficient estimates are statistically insignificant, but one has to be cautious, since the lagged dependent variable obtains a coefficient close to one, which makes measurement imprecise (Blundell and Bond, 1998). Overall, Table 8 provides some evidence that CIT is not a large concern for bank risk.

6 Conclusions

In this paper we estimated the effect of corporate income taxation on bank capital structure and risk. Due to either risk based capital regulation or market based, risk dependent, privately optimal capital ratio targets leverage and risk decisions are potentially interrelated. To tackle this endogeneity, we estimated reduced form regressions, both single equation and simultaneous equation models.

We find that a 10 percentage point increase in the marginal CIT rate leads to an increase in the leverage ratio of about 0.8-1.4 percentage points and a decrease of 2-7 percentage points in risk-weighted assets to total assets. The marginal impact on leverage is smaller than what other papers have previously found, which can be attributed to the inclusion of a broader set of control variables in our regressions. The negative impact of CIT on bank portfolio risk is robust to the type of risk measure: we find lower loan-to-assets and non-performing loan ratios in high tax countries. While attention in existing literature has mostly focused on the leverage incentivizing effect of corporate income taxation, our results imply that the portfolio re-allocation effects are at least as important. Furthermore, the measured effect of corporate income taxes on overall bank risk seems to be modest. We provide evidence that this can be partly attributed to regulation: banks reduce portfolio risk to a larger extent in response to higher taxation in countries where capital regulation is more stringent.

The above results have important policy implications. In particular, they suggest that the elimination of interest deductibility of debt will not make banks safer to the extent that one might have hoped for. In this regard banks are different from non-financial companies as the latter are not regulated and therefore face fewer constraints on asset risk decisions. The analysis also suggests that the primary driver for banks' debt-bias is not corporate income taxation, but rather other factors, such as access to the financial safety net. An approach that seems more effective at reducing banks' debt-bias thus involves the improvement of the resolution regime and the reduction of implicit subsidies to bank risk taking.

The estimated low bank-risk effects do not imply that the tax-bias of debt is without social costs. In particular, in a hypothetical situation in which banks operate efficiently in the absence of taxation, CIT distorts both debt and portfolio decisions. Since investors compare after-tax costs of financing with after-tax returns (while a social planner also internalizes the cost of the tax-shield), investment decisions are inefficient in the absence of regulation. Capital requirements, however, have the potential to reduce this bias, if the reduction in asset risk is achieved by less inefficient lending. While this suggests that the overall welfare losses due to CIT is smaller for banks than for non-financial firms, a thorough assessment of the welfare implications of taxing banks' corporate profits is beyond the scope of this paper.

The above results relate to long run levels of leverage and risk. An additional subtlety arises when one considers the short run effects of taxation. We have shown evidence that while in the long run leverage and portfolio risk move in offsetting directions as a response to taxes, in the short run they seem to be co-moving. A potential explanation to this effect is that in the short run taxes increase risk taking because of moral hazard, but in the long run bank exits ensure that bank profitability is restored and moral hazard becomes relatively unimportant. Thus, this explanation has implications for the tax effects on bank market structure, which is a potential avenue for further research. The co-movement of leverage and portfolio risk in response to tax changes also opens the possibility for taxes to be included in the macroprudential policy tool set, although the mechanism is somewhat counter-intuitive: during credit booms when leverage and asset risk are excessive optimal tax rates are lower (to disincentivize leverage and increase charter value), while in recessions tax rates should be higher (in order to incentivize risk taking through charter values).

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Table 1: Descriptive statistics

	No. of obs.	Mean	St. D.	Minimum	Maximum
CIT	148608	0.382	0.0533	0.100	0.560
CIT dummy	148608	0.956	0.206	0	1
Leverage	148608	0.893	0.0678	0.214	0.979
RWA	106688	0.676	0.138	0.238	1.000
Loans	148608	0.632	0.168	0.0659	0.936
NPL	103624	-4.850	1.660	-9.488	-1.465
Z score	147782	3.219	0.975	.459	5.544
Buffer dummy	127525	0.472	0.499	0	1
Size	148608	12.14	1.470	8.809	16.63
Size^2	148608	149.7	38.33	17.68	454.4
Net interest margin	148608	0.0385	0.0150	0.00500	0.134
ROA	148608	0.00707	0.0121	-0.0530	0.0645
Loan losses	148608	0.00389	0.00640	-0.00439	0.0427
Fee income	148608	0.190	0.151	-0.146	0.968
Wholesale funding	148608	0.0793	0.152	0	0.950
Non-interest expenses	148608	0.0323	0.0339	0.00491	0.453
Foreign subsidiary	148608	0.0319	0.176	0	1
Market share	148608	0.00397	0.0329	3.44e-08	1
Aggregate credit	148608	0.605	0.0612	0	1.060
Basel II	148608	0.202	0.402	0	1
RGDP growth	148608	0.0204	0.0227	-0.177	0.164
CPI	148608	0.0253	0.0204	-0.0638	1.087
Gvt Debt/GDP	148608	0.706	0.227	0.0389	1.864
GDP per capita	148608	10.47	0.411	6.567	10.89
Exchange rate chg	148608	0.000119	0.0577	-0.188	2.198
Activity restrictions	148608	10.79	2.104	4	16
Regulatory stringency	148608	5.343	0.671	2	9
Capital requirements	148608	0.0808	0.00487	0.0600	0.190
Creditor rights	148608	1.338	0.738	0	4

Table 2: Correlation matrix of main variables in level

	CIT	Leverage	RWA	Loans	NPL
CIT	1				
Leverage	0.165***	1			
RWA	-0.00755*	0.124***	1		
Loans	-0.0371***	0.220***	0.748***	1	
NPL	-0.200***	-0.0234***	0.0505***	-0.0230***	1

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3: Correlation matrix of main variables in first difference

	D.CIT	D.Leverage	D.RWA	D.Loans	D.NPL
D.CIT	1				
D.Leverage	0.00803**	1			
D.RWA	0.00981**	0.161***	1		
D.Loans	0.0187***	0.235***	0.696***	1	
D.NPL	-0.00503	0.0204***	-0.0479***	-0.0577***	1

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4: Single equation leverage and RWA regressions

The dependent variable is *Leverage* in columns (1)-(4) and risk-weighted assets to total assets *(RWA)* in columns (5)-(8). Columns (1), (3), (4), (5), (7) and (8) are estimated with OLS on the between-transformed variables. Columns (2) and (6) are estimated with the system GMM estimator. In columns (2) and (6) only the lagged dependent variables are treated as endogenous. In column (2) only the second lag is used as instrument, in column (6) only the third lag. Regressions (2) and (6) include bank and time effects. The sample in regression (6) excludes the years prior to 2004. The two-step estimator with the Windmeijer (2005) correction is applied. The standard errors of the long run marginal effect of CIT in columns (2) and (6) are calculated with the delta method. Standard errors in columns (2) and (6) are clustered at the country level. t statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

	Leverage				RWA			
	Full sample		Pre-crisis	non-US sample	Full sample		Pre-crisis	non-US sample
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Between	GMM	Between	Between	Between	GMM	Between	Between
L.Leverage		0.578***				0.848***		
		(6.70)				(98.38)		
CIT (Short run)		0.0329*				-0.104**		
		(1.85)				(-2.28)		
CIT (Long run)	0.0767***	0.0779	0.139***	0.0941***	-0.209***	-0.686*	-0.694***	-0.163
	(6.37)	(1.82)	(10.80)	(5.39)	(-3.03)	(-2.31)	(-4.82)	(-1.31)
Size	0.0323***	0.0111***	0.0441***	0.0466***	0.0492***	0.00606***	0.0320***	0.0942***
	(13.92)	(4.83)	(16.01)	(10.32)	(10.14)	(4.50)	(5.57)	(5.77)
Size^2	-0.000702***	-0.000288***	-0.00123***	-0.00103***	-0.00124***	-0.000149*	-0.000345	-0.00341***
	(-7.97)	(-3.26)	(-11.56)	(-6.12)	(-6.75)	(-1.88)	(-1.53)	(-6.08)
Net interest margin	-0.695***	0.343***	0.387***	-1.270***	2.696***	0.707***	4.302***	-0.351
	(-13.91)	(3.15)	(6.45)	(-16.48)	(19.51)	(3.70)	(27.05)	(-0.97)
ROA	-0.0401	-1.066***	0.644***	-0.661***	-0.921***	-0.468***	-1.205***	2.661***
	(-0.69)	(-12.33)	(10.11)	(-6.80)	(-6.41)	(-3.38)	(-7.91)	(6.30)
Loan losses	-0.119	-0.346***	0.161	0.191	7.560***	-0.629***	7.033***	8.429***
	(-1.02)	(-3.78)	(1.16)	(1.09)	(24.81)	(-4.25)	(16.87)	(10.74)
Fee income	-0.0311***	0.0136*	0.0351***	-0.0745***	-0.0908***	-0.0244***	-0.0701***	-0.0747**
	(-6.78)	(1.71)	(6.60)	(-10.22)	(-7.32)	(-5.61)	(-4.69)	(-2.07)
Wholesale funding	-0.0652***	-0.00165	-0.0558***	-0.0636***	0.0294**	0.0198	0.0164	0.0247
	(-17.85)	(-0.41)	(-12.83)	(-12.74)	(2.24)	(1.05)	(1.02)	(0.98)
Non-interest expenses	-0.348***	-0.355***	-1.072***	-0.105***	-0.173***	0.197***	-0.362***	0.540***

	(-17.54)	(-7.57)	(-35.42)	(-3.73)	(-2.70)	(6.19)	(-5.03)	(3.09)
Foreign subsidiary	-0.0301***	-0.0158***	-0.0343***	-0.0317***	-0.0283***	-0.00599	-0.0166	-0.0296**
	(-11.67)	(-3.01)	(-10.45)	(-9.39)	(-3.38)	(-0.98)	(-1.30)	(-2.17)
Market share	0.0687***	0.0360**	0.0416***	0.0530***	-0.0585	0.0372*	0.0892	-0.0747
	(5.39)	(2.02)	(2.87)	(3.27)	(-1.42)	(1.84)	(1.16)	(-1.35)
Aggregate credit	0.0647***	0.00796	-0.0145	0.0673***	0.198***	0.0597***	0.163	0.0678
	(6.83)	(0.70)	(-1.31)	(5.28)	(6.51)	(3.29)	(1.54)	(1.47)
Basel II	-0.0578***	-0.00335*		-0.0448***	-0.154***	-0.0164***		-0.0428***
	(-19.10)	(-1.76)		(-9.79)	(-22.31)	(-3.20)		(-2.78)
RGDP growth	-0.346***	0.0838***	-0.335***	-0.329***	-0.972***	-0.0524	-1.890***	-0.675**
	(-6.16)	(2.91)	(-4.58)	(-4.48)	(-4.97)	(-0.37)	(-4.25)	(-2.14)
CPI	0.0206	-0.0262	-0.294***	0.0963**	0.623***	0.0865	3.265***	0.531***
	(0.55)	(-0.98)	(-6.61)	(1.96)	(4.28)	(0.61)	(5.23)	(2.62)
Gvt Debt/GDP	-0.0231***	0.0000955	-0.00794**	-0.0323***	0.0945***	0.0136**	0.168***	0.0964***
	(-7.77)	(0.02)	(-2.18)	(-6.93)	(6.98)	(1.97)	(5.47)	(4.57)
GDP per capita	0.000143	0.00203	-0.0174***	-0.00176	0.0376***	0.00296	0.0912***	0.00945
	(0.08)	(1.02)	(-8.51)	(-0.59)	(6.24)	(0.72)	(5.33)	(0.97)
Exchange rate chg	-0.0332	-0.0212***	-0.0601***	-0.0330	-0.795***	-0.106*	0.542*	-0.782***
	(-1.54)	(-5.91)	(-2.68)	(-1.21)	(-6.73)	(-1.78)	(1.72)	(-4.80)
Activity restrictions	-0.00411***	-0.000928	-0.00420***	-0.00401***	0.00592***	0.000890	-0.0208***	0.00834***
	(-10.18)	(-1.41)	(-7.90)	(-5.34)	(3.80)	(0.64)	(-4.00)	(3.07)
Regulatory stringency	-0.000731	0.000288	0.00434***	-0.00136	-0.00656**	0.0000872	-0.0266***	0.00359
	(-0.87)	(0.29)	(4.49)	(-1.27)	(-2.18)	(0.05)	(-3.67)	(0.90)
Capital requirements	-0.253**	-0.313	-1.995***	0.210	0.464	-0.0122	-0.942	1.481***
	(-2.04)	(-1.51)	(-12.24)	(1.30)	(1.32)	(-0.04)	(-1.00)	(3.03)
Creditor rights	0.00342***	0.00113	0.00187*	0.00390***	0.0207***	-0.00450	-0.0278***	0.00409
	(3.89)	(0.67)	(1.86)	(3.09)	(3.85)	(-1.24)	(-2.86)	(0.54)
Constant	0.683***	0.283***	0.888***	0.553***	-0.401***	-0.0271	-0.272	-0.407**
	(21.88)	(3.75)	(23.25)	(10.45)	(-4.28)	(-0.39)	(-1.15)	(-2.17)
Observations	148608	129378	98563	39641	106688	62806	65053	5268
AR(1) test p-value		0.000				0.000		
AR(2) test p-value		0.221				0.00414		
AR(3) test p-value						0.950		
Hansen test p-value		0.387				0.923		

Table 5: Single equation regressions on alternative portfolio risk measures

The dependent variable is total loans to total assets (*Loans*) in columns (1)-(4) and log-share of non-performing loans to total loans (*NPL*) in columns (5)-(8). Columns (1), (3), (4), (5), (7) and (8) are estimated with OLS on the between-transformed variables. Columns (2) and (6) are estimated with the system GMM estimator. In columns (2) and (6) only the lagged dependent variables are treated as endogenous. In column (2) only the second lag is used as instrument, in column (6) only the third lag. Regressions (2) and (6) include bank and time effects. The two-step estimator with the Windmeijer (2005) correction is applied. The standard errors of the long run marginal effect of CIT in columns (2) and (6) are calculated with the delta method. Standard errors in columns (2) and (6) are clustered at the country level. t statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

	Loans				NPL			
	Full sample		Pre-crisis	non-US sample	Full sample		Pre-crisis	non-US sample
	(1) Between	(2) GMM	(3) Between	(4) Between	(5) Between	(6) GMM	(7) Between	(8) Between
L.Loans		0.928***				0.665***		
		(81.95)				(38.27)		
CIT (Short run)		-0.0656*				-1.485***		
		(-1.82)				(-2.63)		
CIT (Long run)	-0.231***	-0.906	-0.314***	-0.110***	-5.844***	-4.431*	-7.682***	0.369
	(-8.64)	(-1.79)	(-10.90)	(-3.21)	(-15.16)	(-2.57)	(-17.43)	(0.69)
Size	0.0751***	-0.00123	0.0851***	0.0603***	-0.0981**	0.0385**	-0.426***	0.0329
	(14.56)	(-0.68)	(13.84)	(6.78)	(-2.51)	(2.07)	(-8.26)	(0.42)
Size^2	-0.00209***	0.0000285	-0.00259***	-0.00176***	0.00369**	-0.00110	0.0150***	-0.00131
	(-10.68)	(0.51)	(-10.92)	(-5.30)	(2.50)	(-1.45)	(7.57)	(-0.46)
Net interest margin	1.688***	0.622***	2.836***	0.587***	-0.230	-2.713**	1.062	3.856***
	(15.17)	(2.73)	(21.16)	(3.87)	(-0.26)	(-2.32)	(0.83)	(3.03)
ROA	-0.714***	-0.736***	-0.601***	0.161	-14.20***	-2.743***	-9.720***	-5.200***
	(-5.48)	(-2.94)	(-4.23)	(0.84)	(-13.33)	(-8.18)	(-6.46)	(-3.27)
Loan losses	5.882***	-0.633**	5.417***	4.750***	61.48***	24.41***	54.67***	42.56***
	(22.65)	(-2.03)	(17.51)	(13.76)	(31.42)	(15.32)	(18.33)	(14.67)
Fee income	-0.280***	-0.00768	-0.179***	-0.363***	0.0751	0.0326	0.266**	0.105
	(-27.48)	(-1.19)	(-15.09)	(-25.28)	(0.89)	(1.17)	(2.25)	(0.77)
Wholesale funding	0.0390***	0.0161	0.0602***	0.0329***	0.0888	0.00561	-0.0462	-0.171*
	(4.79)	(1.26)	(6.20)	(3.35)	(1.17)	(0.06)	(-0.42)	(-1.79)
Non-interest expenses	-0.0271	0.0330	-0.727***	0.291***	-0.0114	0.753*	-0.0607	-0.241

	(-0.61)	(1.35)	(-10.76)	(5.23)	(-0.03)	(1.95)	(-0.08)	(-0.57)
Foreign subsidiary	-0.0477***	-0.00551	-0.0585***	-0.0441***	-0.134***	0.0259	0.00378	-0.102*
	(-8.32)	(-1.44)	(-7.99)	(-6.62)	(-2.78)	(0.62)	(0.05)	(-1.77)
Market share	0.247***	0.0432**	0.336***	0.247***	0.834***	0.285	1.329***	0.505*
	(8.71)	(2.15)	(10.37)	(7.75)	(3.58)	(1.11)	(4.37)	(1.91)
Aggregate credit	0.661***	0.0874***	0.706***	0.613***	0.651***	-0.131	2.016***	0.193
	(31.34)	(4.19)	(28.60)	(24.37)	(3.45)	(-0.39)	(7.15)	(0.83)
Basel II	0.00489	-0.0147***		0.0247***	0.124***	-0.0267		0.299***
	(0.73)	(-2.82)		(2.73)	(2.76)	(-0.74)		(4.06)
RGDP growth	-0.329***	0.0803	-0.286*	-0.298**	-6.316***	-4.110***	-5.280***	-5.923***
	(-2.63)	(0.99)	(-1.75)	(-2.06)	(-7.09)	(-3.61)	(-3.79)	(-5.16)
CPI	-0.190**	-0.0463	-0.607***	-0.0271	-0.921	0.470	-5.694***	0.693
	(-2.26)	(-0.44)	(-6.11)	(-0.28)	(-1.29)	(0.99)	(-5.39)	(0.82)
Gvt Debt/GDP	-0.0995***	0.00110	-0.0735***	-0.120***	2.262***	0.766***	2.468***	1.323***
	(-15.03)	(0.11)	(-9.06)	(-13.10)	(43.14)	(15.24)	(36.07)	(15.63)
GDP per capita	0.0305***	0.00268	0.00843*	0.0321***	-0.837***	-0.223***	-1.112***	-0.334***
	(7.80)	(0.46)	(1.84)	(5.47)	(-26.64)	(-4.28)	(-24.83)	(-7.27)
Exchange rate chg	-0.0421	-0.0334	-0.0252	-0.0976*	-1.127***	-0.661***	0.0396	-0.820**
	(-0.88)	(-1.46)	(-0.50)	(-1.81)	(-3.70)	(-5.71)	(0.11)	(-2.32)
Activity restrictions	-0.00515***	-0.00208***	-0.00689***	-0.00175	-0.00925	0.0303**	0.000694	0.0544***
	(-5.73)	(-2.83)	(-5.81)	(-1.18)	(-0.96)	(2.45)	(0.04)	(4.27)
Regulatory stringency	0.00136	-0.00131	0.00489**	0.00311	-0.0121	0.00763	-0.00681	-0.0187
	(0.73)	(-0.48)	(2.26)	(1.47)	(-0.72)	(0.27)	(-0.30)	(-0.99)
Capital requirements	-1.108***	-0.376*	-3.469***	-0.695**	12.41***	2.434	13.19***	14.22***
	(-4.01)	(-1.82)	(-9.54)	(-2.18)	(5.67)	(0.69)	(3.86)	(5.47)
Creditor rights	-0.0132***	-0.00198	-0.0160***	-0.0192***	0.0167	-0.0613	0.144***	-0.110***
	(-6.74)	(-0.96)	(-7.13)	(-7.72)	(0.74)	(-1.24)	(4.16)	(-4.22)
Constant	-0.391***	0.0436	-0.0682	-0.290***	3.833***	0.197	8.245***	-3.389***
	(-5.63)	(0.58)	(-0.80)	(-2.78)	(7.21)	(0.27)	(10.11)	(-3.92)
Observations	148608	129378	98563	39641	103624	84882	61690	15426
AR(1) test p-value		0.000				0.000		
AR(2) test p-value		0.958				0.000		
AR(3) test p-value						0.577		
Hansen test p-value		0.335				0.193		

Table 6: Effect of regulation

The dependent variables are *Leverage* in columns (1) and (3) and risk-weighted assets over total assets (*RWA*) in columns (2) and (4). All regressions are estimated with OLS on the between-transformed variables. t statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

	(1) Leverage	(2) RWA	(3) Leverage	(4) RWA
CIT (Long run)	0.0509***	-0.129*	0.237***	0.960***
	(2.91)	(-1.91)	(3.60)	(3.58)
CIT * Buffer dummy	0.229***	-0.252***		
	(11.39)	(-4.46)		
CIT * Regulatory stringency			-0.0286**	-0.209***
			(-2.47)	(-4.52)
Buffer dummy	-0.132***	0.00591		
	(-17.24)	(0.27)		
Size	0.0114***	0.0294***	0.0323***	0.0487***
	(5.91)	(6.50)	(13.94)	(10.05)
Size^2	-0.000295***	-0.000850***	-0.000702***	-0.00121***
	(-4.07)	(-4.96)	(-7.97)	(-6.55)
Net interest margin	0.0211	2.401***	-0.691***	2.685***
	(0.41)	(18.49)	(-13.82)	(19.44)
ROA	-0.0248	-0.941***	-0.0410	-0.908***
	(-0.45)	(-7.03)	(-0.70)	(-6.33)
Loan losses	-0.545***	6.976***	-0.109	7.479***
	(-4.58)	(24.46)	(-0.93)	(24.53)
Fee income	0.0352***	-0.123***	-0.0306***	-0.0918***
	(7.78)	(-10.64)	(-6.69)	(-7.40)
Wholesale funding	-0.0330***	0.0457***	-0.0656***	0.0294**
	(-7.98)	(3.72)	(-17.94)	(2.24)
Non-interest expenses	-0.758***	0.0552	-0.352***	-0.177***
	(-31.84)	(0.92)	(-17.69)	(-2.76)
Foreign subsidiary	-0.00992***	-0.0144*	-0.0299***	-0.0288***
	(-3.65)	(-1.82)	(-11.62)	(-3.44)
Market share	0.0723***	-0.0691*	0.0703***	-0.0392
	(6.21)	(-1.80)	(5.51)	(-0.95)
Aggregate credit	0.0688***	0.142***	0.0641***	0.224***
	(7.18)	(4.93)	(6.77)	(7.25)
Basel II	-0.0270***	-0.121***	-0.0584***	-0.153***
	(-9.43)	(-18.38)	(-19.23)	(-22.03)
RGDP growth	0.0163	-1.037***	-0.351***	-1.002***
	(0.26)	(-5.63)	(-6.25)	(-5.13)
CPI	0.000693	0.691***	0.0243	0.674***
	(0.02)	(5.12)	(0.64)	(4.62)
Gvt Debt/GDP	0.00592**	0.0901***	-0.0229***	0.0824***
	(2.04)	(7.08)	(-7.71)	(5.98)
GDP per capita	-0.00285	0.0366***	-0.000843	0.0322***
	(-1.63)	(6.44)	(-0.47)	(5.24)

Exchange rate chg	-0.0100	-0.795***	-0.0417*	-0.826***
	(-0.36)	(-7.21)	(-1.92)	(-6.98)
Activity restrictions	-0.00245***	0.00779***	-0.00418***	0.00424***
	(-5.46)	(5.22)	(-10.34)	(2.66)
Regulatory stringency	-0.000655	-0.00455	0.00746**	0.0462***
	(-0.79)	(-1.62)	(2.18)	(3.83)
Capital requirements	-0.728***	0.480	-0.318**	0.127
	(-6.12)	(1.46)	(-2.51)	(0.35)
Creditor rights	0.00742***	0.0170***	0.00385***	0.0228***
	(6.99)	(3.35)	(4.30)	(4.23)
Constant	0.888***	-0.186**	0.652***	-0.614***
	(29.19)	(-2.10)	(19.37)	(-5.85)
Observations	127525	106606	148608	106688

Table 7: Two-equation simultaneous regressions

The dependent variables are *Leverage* and risk-weighted assets over total assets *(RWA)*. *CIT (Short run)* is the contemporaneous level of CIT rate in regression (1). *D.CIT* is the first difference, *L.CIT* is the first lag of *CIT*. *CIT (Long run)* is the long run marginal effect if *CIT* and its standard error is calculated with the delta method. All regressions are estimated with 3SLS. Time effects are included in the regressions. t statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

	(1)		(2)	
	D.Leverage	D.RWA	D.Leverage	D.RWA
CIT (Short run)	0.0297***	-0.164***		
	(3.12)	(-8.06)		
D.CIT (Short run)			0.0756***	0.145**
			(2.81)	(2.56)
L.CIT (Short run)			0.0253**	-0.193***
			(2.57)	(-9.22)
CIT (Long run)	0.0871**	-1.705***	0.0740*	-2.011***
	(3.12)	(-8.02)	(2.57)	(-9.16)
L.Leverage	-0.341***		-0.341***	
	(-196.32)		(-196.54)	
L.RWA		-0.0960***		-0.0961***
		(-61.25)		(-61.36)
D.Leverage		-5.378***		-5.368***
		(-52.88)		(-52.77)
D.Leverage * Buffer dummy		6.000***		5.990***
		(60.29)		(60.18)
D.RWA	0.0586***		0.0581***	
	(3.52)		(3.49)	
D.RWA * Buffer dummy	0.129***		0.130***	
	(7.89)		(7.93)	
Size	0.00765***	0.0101***	0.00765***	0.0101***
	(18.59)	(11.65)	(18.61)	(11.65)
Size^2	-0.000242***	-0.000391***	-0.000242***	-0.000391***
	(-15.25)	(-11.66)	(-15.27)	(-11.64)
Net interest margin	0.411***	0.622***	0.412***	0.624***
	(36.89)	(25.10)	(36.96)	(25.18)
ROA	-1.096***	-0.745***	-1.096***	-0.740***
	(-92.72)	(-23.29)	(-92.80)	(-23.16)
Loan losses	-0.340***	0.0922**	-0.341***	0.0927**
	(-15.61)	(2.15)	(-15.65)	(2.16)
Fee income	0.0249***	-0.0264***	0.0248***	-0.0267***
	(24.86)	(-12.48)	(24.83)	(-12.61)
Wholesale funding	0.00579***	0.0277***	0.00565***	0.0266***
	(4.67)	(10.46)	(4.56)	(10.06)
Non-interest expenses	-0.306***	0.108***	-0.306***	0.108***
	(-51.26)	(8.71)	(-51.30)	(8.75)
Foreign subsidiary	-0.0108***	-0.00449**	-0.0108***	-0.00456**
	(-11.56)	(-2.27)	(-11.59)	(-2.31)

Market share	0.0163***	0.0861***	0.0159***	0.0828***
	(2.80)	(6.95)	(2.73)	(6.68)
Aggregate credit	0.00858*	0.0782***	0.00694	0.0670***
	(1.72)	(7.36)	(1.37)	(6.22)
Basel II	-0.00119	-0.0221***	-0.000483	-0.0173***
	(-1.00)	(-8.74)	(-0.39)	(-6.51)
RGDP growth	0.115***	0.301***	0.110***	0.270***
	(4.05)	(4.99)	(3.89)	(4.45)
CPI	0.0339**	-0.000703	0.0395***	0.0367
	(2.46)	(-0.02)	(2.80)	(1.22)
Gvt Debt/GDP	-0.00292	0.0391***	-0.00297	0.0387***
	(-1.53)	(9.57)	(-1.56)	(9.48)
GDP per capita	0.00379***	0.00492**	0.00368***	0.00423**
	(3.90)	(2.38)	(3.79)	(2.04)
Exchange rate chg	0.0145	-0.0897***	0.0106	-0.116***
	(1.64)	(-4.79)	(1.17)	(-6.01)
Activity restrictions	-0.000385	0.000574	-0.000339	0.000890*
	(-1.64)	(1.15)	(-1.43)	(1.77)
Regulatory stringency	-0.00292***	0.00419***	-0.00286***	0.00463***
	(-5.74)	(3.87)	(-5.61)	(4.27)
Capital requirements	-0.0256	-0.283**	-0.0313	-0.321**
	(-0.44)	(-2.27)	(-0.53)	(-2.57)
Creditor rights	0.00171**	-0.00270	0.00164**	-0.00316*
	(2.16)	(-1.61)	(2.07)	(-1.87)
Observations	95212		95212	

Table 8: Z-score regressions

The dependent variable in columns (1) and (2) is the natural logarithm of Z score *(Z score)*. Columns (1) is estimated with OLS on the between-transformed variables. Regression (2) is estimated with the system GMM estimator with only the lagged dependent variable treated as endogenous, instrumented only by the third lag. Column (2) includes bank and time effects as well. The two-step estimator with the Windmeijer (2005) correction is applied. The standard errors of the long run marginal effects of CIT in column (2) are calculated with the delta method. Standard errors in column (2) are clustered at the country level. t statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

	Z score	
	(1) Between	(2) GMM
L.Z score		0.944***
		(142.20)
CIT (Short run)		0.0494
		(0.33)
CIT (Long run)	1.380***	0.884
	(7.93)	(0.33)
Size	0.0209	-0.000906
	(0.64)	(-0.10)
Size^2	-0.000517	0.000311
	(-0.41)	(0.87)
Net interest margin	9.044***	2.764***
	(14.61)	(9.42)
Loan losses	-78.35***	-13.77***
	(-48.80)	(-8.80)
Fee income	-0.522***	0.173***
	(-8.38)	(2.65)
Wholesale funding	0.0462	-0.0516***
	(0.89)	(-3.13)
Non-interest expenses	-2.302***	-0.700**
	(-8.35)	(-2.50)
Foreign subsidiary	-0.272***	-0.0258*
	(-7.45)	(-1.91)
Market share	0.183	-0.0892
	(0.97)	(-1.09)
Aggregate credit	2.319***	0.00946
	(17.21)	(0.13)
Basel II	0.204***	0.0116
	(4.69)	(0.69)
RGDP growth	7.287***	-0.580***
	(9.04)	(-2.87)
CPI	-3.928***	-0.560***
	(-7.23)	(-2.99)
Gvt Debt/GDP	-0.247***	0.00706
	(-5.85)	(0.24)
GDP per capita	-0.0787***	-0.0168

	(-3.12)	(-0.83)
Exchange rate chg	0.252	0.119**
	(0.79)	(2.13)
Activity restrictions	-0.172***	-0.00886**
	(-29.77)	(-2.47)
Regulatory stringency	0.0150	0.00622
	(1.24)	(0.79)
Capital requirements	-2.057	-0.727
	(-1.16)	(-0.72)
Creditor rights	0.0663***	0.0202*
	(5.26)	(1.73)
Constant	3.983***	0.385
	(8.96)	(1.23)
Observations	147782	128622
AR(1) test p value		0.000
AR(2) test p value		0.000
AR(3) test p value		0.860
Hansen test p value		0.379

7 Appendix

Table 9: Definition and source of variables

Variable	Definition	Source
CIT	Top statutory corporate income tax rate.	OECD; KPMG Corporate and Indirect Tax Surveys 2007, 2010 and 2011
CIT dummy	1 if CIT is higher than the average CIT rate in the sample, which is 27.31% and 0 otherwise.	OECD; KPMG Corporate and Indirect Tax Surveys 2007, 2010 and 2011
Leverage	Total liabilities over total assets.	Bankscope
RWA	Risk-weighted assets over total assets.	Bankscope
Loans	Total loans to total assets.	Bankscope
NPL	Natural logarithm of non-performing loans to total loans.	Bankscope
Buffer dummy	1 if a bank has a regulatory capital buffer on average more than the median, which is 0.074 and 0 otherwise. Regulatory capital buffer is Tier I + Tier 2 capital over risk-weighted assets minus capital requirements.	Bankscope and Barth et al. (2001), Barth et al. (2004), Barth et al. (2008)
Z score	Natural logarithm of Z score = (Total equity/Total assets + ROA) / standard deviation of ROA.	Bankscope
Size	Natural logarithm of the book value of total assets.	Bankscope
$Size^2$	The square of the natural logarithm of the book value of total assets.	Bankscope
Net interest margin	Net interest margin.	Bankscope
ROA	Return over average assets.	Bankscope
Loan losses	Loan loss provisions over total assets.	Bankscope
Fee income	Non-interest income over total operating income.	Bankscope

Wholesale funding	Non-deposit funding over total deposits and short term funding.	Bankscope
Non-interest expenses	Non-interest expenses over total assets.	Bankscope
Foreign subsidiary	1 if a bank has an ownership structure with at least 51% foreign owners and 0 otherwise.	Bankscope
Market share	Total assets relative to the sum of all other banks' assets in the country of residence.	Bankscope
Aggregate credit	Sum of all other banks' loans relative to all banks' assets in the country of residence.	Bankscope
Basel II	1 if the Basel II rules were effective in the country of residence and 0 otherwise.	BIS progress reports on the implementation of the Basel regulatory framework
RGDP growth	Annual percentage change of constant price GDP.	World Economic Outlook database
CPI	Inflation, annual end of period consumer price change.	World Economic Outlook database
Gvt Debt/GDP	General government gross debt to GDP.	World Economic Outlook database
GDP per capita	GDP per capita on a US dollar PPP basis.	World Economic Outlook database
Exchange rate chg	Annual percentage point changes in the nominal exhange rate.	World Economic Outlook database
Activity restrictions	Index of regulatory restrictions of certain activities.	Barth et al. (2001), Barth et al. (2004), Barth et al. (2008), Čihák et al. (2012)
Regulatory stringency	Index of regulatory stringency of capital calculation rules.	Barth et al. (2001), Barth et al. (2004), Barth et al. (2008), Čihák et al. (2012)
Capital requirements	Minimum capital adequacy requirement expressed as a percentage of Tier I + Tier 2 capital over risk-weighted assets.	Barth et al. (2001), Barth et al. (2004), Barth et al. (2008), Čihák et al. (2012)
Creditor rights	An index of statutory rights of shareholders.	Djankov et al. (2007)