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Abstract

Corporate income taxation (CIT) in most countries favors debt over equity financing, leading to over-indebtedness. This problem is particularly acute for the financial sector. We estimate financial-stability benefits of eliminating this debt bias. We estimate the long-run effects of CIT on bank leverage and, using a Vasicek-based model of banking crisis losses, we find that eliminating this debt bias could reduce public finance losses in the range of 30 to 70%. These results hold even for conservative estimates of bank-leverage and portfolio-risk effects of CIT changes.

JEL Classification: G01, G28, G32 and H25

Keywords: capital structure, debt bias, public finance, systemic risk and taxation

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1 Introduction

In the period 2008-2012, recapitalization and asset relief measures by EU governments amounted to around 600 bn euro, a little bit less than 5% of EU 2012 GDP[1]. A range of explanatory factors have been identified as causes for the severity of the crisis and the large public finance costs. Excessive bank leverage was certainly a major driver of contagion risks and public finance costs[2]. While regulatory and supervisory measures were clearly deficient, tax rules did not lean against the wind. In many cases, taxation even leaned in the wrong direction, encouraging excessive debt financing, complex financial transactions, poorly designed incentive compensation for corporate managers, and highly leveraged home ownership[3].

The impact of the debt bias induced by corporate taxation on financial stability is a novel topic. The topic has recently attracted policy attention. In its 2015 Green Paper on Building a Capital Market Union (see [5]), the European Commission stresses the problem that "Differences in the tax treatment of debt and equity financing might increase the reliance of companies on debt and bank funding.

In this paper we focus on the corporate income tax (CIT) effects on bank leverage, financial stability and public finance costs of financial crises.

The theoretical framework for the impact of taxation on leverage builds on extensions of the Modigliani-Miller capital structure irrelevance proposition (see [21, 22]). The original proposition suggests that leverage of a firm has no effect on the market value of the firm. When corporate income tax is added to the original irrelevance proposition, firms have an incentive to lean towards debt financing as interest payments shield earnings from taxes: interest payments on debt reduce the firm's taxable income while dividends and share repurchases do not. Modigliani-Miller show that in the context of CIT firm value can be increased using debt financing rather than equity financing. If there would be no offsetting cost of debt,

[1] In addition, guarantees and other form of liquidity supports peaked at 906 billion euro (7.7% of EU 2012 GDP) in 2009. Source: *http : //ec.europa.eu/competition/state_aid/scoreboard/financial _economic_crisis_aid_en.html*

[2] Diamond and Rajan (2009), Crotty (2009), Laeven et al (2010), and Valencia (2011) (see [11, 6, 28]) provide an overview of causes of the financial crisis, including high bank leverage, excessive short-term debt, hidden off-balance-sheet risks, monetary policy and excessive risk-taking, in a context of regulatory and supervisory deficiencies.

[3] Shaviro, Shackelford et al., Lloyd, Hemmelgarn and Nicodeme and IMF)see ([26, 15, 16, 20]) discuss the role of tax distortions in the financial crisis.

firms would tend towards 100% debt financing. Following Kraus and Litzenberger (see [19]) and Myers [23] most studies consider the deadweight costs of bankruptcy as a counterweight to avoid a corner solution with 100% debt financing. Firms balance the tax benefits of debt against the costs of financial distress. Tax effects dominate at low leverage, while distress costs dominate at high leverage. The firm has an optimal, or target, leverage ratio at which the marginal value of tax shields from a small change in leverage exactly offsets the incremental distress costs. This target optimal debt ratio is determined by firm characteristics like profitability and asset risk and the level of CIT. Removing the debt bias of CIT would provide a level playing field between debt and equity and reduce the targeted leverage of firms. Considering the large social costs of financial crises due to excessive bank leverage and regulatory efforts to increase banks capital, the benefits of elimination of tax incentives for holding debt, or even a tax scheme favoring equity over debt, may be particularly desirable for banks.

There is abundant empirical work on the effect of the debt bias of CIT on debt-financing for non-financial corporations (NFCs). Most papers exclude banks from the analysis, considering that the decisions on funding may be very different for banks. Compared to NFCs, leverage ratios of banks are generally much higher and subject to regulatory requirements that may, to a large extent, drive their financing decisions. Ex ante, one could consider the possibility that the impact of regulation, information asymmetry, agency costs and bankruptcy costs, as well as the implicit and explicit guarantees on liabilities, could possibly dwarf the marginal costs and benefits of tax optimization as drivers of bank leverage. Moreover, while banks continuously raise and roll-over debt of different forms, raising new equity or reducing dividends to increase capital may have important transaction and reputation costs. If so, taxation would not be an important driver of strategic decisions on banks' choice between debt and equity financing, and identifying an impact of the CIT on funding might prove more challenging than for NFCs. A number of recent studies confirm however that the CIT does affect banks capital structure significantly. These are discussed in the next section.

This study adds to this small but rapidly growing literature of empirical research pointing to a relation between corporate taxation, bank leverage and costs of financial crises. We first estimate the effect of corporate taxation on bank leverage with a series of panel regressions, building on the methodology of Keen and Mooij (see [8]), but focusing on European banks.

In a second step, we gauge the potential reduction in public finance costs in financial crises that would result from reducing banks' incentives for debt financing compared to equity financing, using an actual bank balance-sheet-based model of costs of systemic crisis for six EU countries. Finally, we show under which conditions the results hold when varying the elasticity of leverage to CIT, when asset portfolio risk is adjusted together with bank leverage, and when allowing for increased asset portfolio risk.

2 The tax elasticity of bank leverage

2.1 Literature review

The impact of taxation on bank leverage has been recently the subject of a small but growing literature. Contrary to what was believed prior to the financial crisis, a number of recent studies confirm that the CIT does affect banks capital structure significantly. Table I below briefly reviews this literature to give an idea of the order of magnitude of the long-run effect of CIT on bank leverage and its variability across studies.

[insert Table I here]

Using bank level data, Keen and de Mooij (2012) and De Mooij et al. (2014) (see [8, 9]) find a long-run CIT impact on bank leverage close to what the literature covering NFCs has found within a range of $(0.14, 0.31)$. Horvath (see [18]) reproduces the Keen and Mooij regressions with a different set of control variables finding a somewhat lower range $(0.08, 0.14)$. An important driver of the lower results is the introduction of a Basel II dummy. When he drops this dummy, the lower-bound coefficient estimate of CIT increases from 0.08 to 0.18. He also notes that restricting the sample to the years prior the financial crisis increases the level of significance and the size of the long-term CIT effect, suggesting that factors other than taxation are more relevant for bank capitalization in distressed periods. Gu et al.(see [14]) examine 86 multinational banks' and 558 subsidiaries' capital structures and find that the leverage structure depends on CIT in two ways: (i) through the the traditional debt bias and (ii) because of tax differentials leading to cross-border debt-shifting. They find a long run-effect of local CIT on bank leverage in the range of $(0.25, 0.34)$, half of which is attributable to international tax differences and half to the traditional debt-bias effect.

Hemmelgarn and Teichmann (see [16]) look at how banks change their leverage, dividend policy and earnings management in reaction to tax rate changes and find a long-run effect of CIT on leverage for banks within the range of Horvath at 0.10. For the period $1991-2004$ Gropp and Heider (see [13]) also find that similarities between banks and non-financial firms' capital structure may be greater than previously thought. Standard cross-sectional determinants of non-financial firms' leverage carry over to banks, except for banks whose capital ratio is close to the regulatory minimum. Schandlbauer (2013) using a difference-in-differences methodology shows that an increase in the local U.S. state corporate tax rate affects both sides of the banks' balance sheet. Banks that are exposed to a tax increase, raise their non-depository debt by approximately 5.9% one period prior to the enactment of the tax change. The overall average however hides a large cross-sectional heterogeneity: better-capitalized banks have the financial flexibility to increase their debt and benefit from an enlarged tax shield. Worse-capitalized banks instead constrain the expansion of customer loans, as their after-tax capital and cash are reduced.

In this paper, using data for the period 2001-2011 on European banks, we find a long-run CIT impact on bank leverage of up to 0.33. The estimate is robust to controlling for the introduction of Basel II, but fragile to the exclusion of German banks that constitute half of the banks in our sample. More details of the empirical analysis are given in the following sections. These results would support the idea that ending the preferential tax treatment of debt could be a promising avenue to reduce risky leverage of banks and thus reduce the vulnerability of the banking system to future shocks.

2.2 Data description

Balance sheet features for more than $3,000$ European banks, for the period $2001-2011$, are taken from the Bankscope database. This is a global database of banks' financial statements provided by Bureau Van Dijk Electronic Publishing. We include commercial, savings or cooperative banks as defined in Bankscope. Only active banks with unconsolidated accounts are considered, excluding banks under liquidation, takeover or merger. Our sample covers 27 EU countries with percentage number of banks over the total reported in parenthesis: Austria (AT, 6.7%), Belgium (BE, 1.0%), Bulgaria (BG, 0.6%), Cyprus (CY, 0.3%), Czech Republic (CZ, .5%), Denmark (DK, 2.8%), Finland (FI, 0.3%), France (FR, 5.8%), Germany

(DE, 46.3%), Greece (GR, 0.5%), Ireland (IE, 0.3%), Italy (IT, 18.7%), Luxembourg (LU, 1.9%), Malta (MT, 0.2%), Netherlands (NL, 0.6%), Portugal (PT, 0.6%), Spain (ES, 3.5%), Sweden (SE, 2.4%), United Kingdom (UK, 2.8%), Estonia (EE, 0.1%), Hungary (HU, 0.5%), Latvia (LV, 0.7%), Lithuania (LT, 0.3%), Poland (PL, 1.2%), Romania (RO, 0.7%), Slovakia (SK, 0.3%), and Slovenia (SI, 0.5%). Notice that German and Italian banks account for more than 60% of the total. The following bank-specific characteristics are taken from Bankscope:

- Total assets (TA, millions euro) which includes total earning assets, cash and due from banks, foreclosed real estate, fixed assets, goodwill, other intangibles, current tax assets, deferred tax, discontinued operations, other assets;

- Total liabilities (TL, millions euro) which includes total interest-bearing liabilities, fair value portion of debt, credit impairment reserves, reserves for pension and other, tax liabilities, other deferred liabilities, discontinued operations, insurance, other non-interest-bearing liabilities;

- Risk weighted assets (RWA, millions euro) a bank's assets exposures, weighted according to risk identified by the Basel regulation;

- Tier 1 regulatory capital (T1, millions euro) is a measure of capital adequacy under the Basel rules which includes only permanent shareholders' equity and disclosed reserves;

- Tier 2 regulatory capital (T2, millions euro) is a measure of capital adequacy under the Basel rules which includes subordinated debt, hybrid capital, loan loss reserves and the valuation reserves as a percentage of risk weighted assets and off balance sheets risks

- Total regulatory capital (K, millions euro) i.e. the capital adequacy under the Basel rules. It is the sum of T1 and T2.

- Return on average assets (ROA, pp) is the ratio of the net income to average total assets.

Using the information above, we construct bank-specific variables used or tested in the panel regressions of section 2.3:

(i) Leverage ratio (LEV, pp) computed as the ratio of total liabilities to total assets;

(ii) Log total assets (log-TA) defined as the logarithm of TA;

(iii) Total assets squared (TA^2) defined as the square of logarithm of TA, and used as a proxy of the bank size;

(iv) Risk weighted asset density (RWAD, pp) defined as the ratio of risk weighted assets to total assets[4];

(v) Return on average assets (ROA, pp) is used as a proxy for the profitability of banks' assets;[5].

Moreover, for each country, the following country-specific variables are considered from various sources:

(vi) The corporate income tax rate (CIT, pp, source: European Commission (2013)).

(vii) The real GDP growth rate (GDP, pp, source: Ameco).

(viii) Inflation (INF, pp, source: Ameco) from the GDP defaltor;

(ix) Non-performing loans (NPL, source: International Monetary Fund, Global Financial Stability Report) represents bank non-performing loans to total gross loans are the value of non-performing loans divided by the total value of the loan portfolio (including non-performing loans before the deduction of specific loan-loss provisions). The loan amount recorded as non-performing is the gross value of the loan as recorded on the balance sheet, not just the amount that is overdue.

(x) Credit (CRED, source: the International Monetary Fund, Global Financial Stability Report): Domestic credit by the banking sector to GDP is an indicator of banking sector development and depth. Domestic credit provided by the banking sector includes all credit to various sectors on a gross basis, with the exception of credit to the central government, which is net. The banking sector includes monetary authorities and deposit money banks, as well as other banking institutions where data are available (including institutions that do not accept transferable deposits but do incur such

[4]When the risk-weighted assets of a specific bank are missing we replace it with the ratio of the total regulatory capital to the regulatory-total-capital ratio or with the ratio of the regulatory Tier 1 capital to the Tier1-regulatory-capital ratio.

[5]Profitability is an important variable in this context. Profits determine the benefit that a firm has from tax deductibility. Profits also directly affect leverage as they add to the value of assets. Lewellen and Lewellen (2006) argue that firms have three, not two, distinct sources of funds: debt, internal equity, and external equity. Internal equity (retained earnings) is generally less costly than external equity for tax reasons, and may even be cheaper than debt. It follows that, without any information problems or adjustment costs, optimal leverage is a function of internal cash-flows.

liabilities as time and savings deposits). Examples of other banking institutions are savings and mortgage loan institutions and building and loan associations.

(xi) Real interest rate (RIR, pp, source: Eurostat): The real interest rate calculated by taking the MFI interest rates[6] minus the GDP deflator.

Banks for which leverage is lower than 60% and larger than 99% have been excluded from the sample, as leverage ratios below 60% generally reflect institutions that do not have the characteristics of a bank, and leverage ratios above 99% mostly concern banks in distress, not meeting regulatory capital requirements. Table II reports some descriptive statistics for the variables under study. In particular, for each variable we show the number of observations, the minimum and maximum, the 5-th and 95-th percentiles and the standard deviation.

[insert Table II here]

More than 90% of the leverage ratio distribution ranges between 82 and 96%. The leverage ratio has a standard deviation of 5, slightly less volatile than reported by Keen and de Mooij (2012) and de Mooij et al (2014) (see [8, 9]). The average corporate income tax rate across years varies in 90% of the cases between 25 and 40% with a minimum value of 10 and a maximum value of 40% and a tendency to decrease through the years: the median in 2001 was equal to 38% dropping to 30% by 2011. Log total assets is on average lower than the one reported in Keen and de Mooij (2012) (see (see [8])) but more volatile with a standard deviation of 1.73 against 1.37. No main differences appear comparing these statistics with those obtained without imposing bounds on the leverage ratio.

A bird's-eye view at the data shows that the relation between CIT and leverage is not so apparent. The situation is displayed in Figure 1.

[insert Figure 1 here]

There appears to be only a weak linear correlation between leverage and CIT when considering the full sample, including non-EU banks, as used by Keen and de Mooij (2012) and de Mooij et al (2014) (see [8, 9]). Also, when constraining the sample by excluding

[6] MFI interest rate statistics cover those interest rates that resident monetary financial institutions apply to euro-denominated deposits and loans by households and non-financial corporations which are residents of the euro area.

unleveraged institutions that do not have the leverage characteristic of a bank (cut-off 60%), the correlation does not increase. When considering only EU banks, the linear correlation increases but heterogeneity still dominates.

This suggests that shedding light on the relation between taxation and bank leverage is difficult and depends heavily on the choice of control variables. The study needs to take account of some important challenges due to changes and shocks in the banking landscape in the period considered. Some of the developments may be associated with structural breaks in the drivers of leverage. In particular, regulatory arbitrage may have blurred the measures of bank leverage and debt, as well as changed its drivers[7]. One important driver is the introduction of Basel II with internal-rating-based assessment of risk-weighted assets. The implementation has been phased differently across countries and the ex-post assessment is that the Basel II capital requirement framework led to insufficient regulatory capital requirement for trading banks and encouraged high leverage[8].

[7]Gropp and Heider (see [13]), assessing the drivers of the bank capital structure, chose 2004 as the end-point of their data series in order to avoid the confounding effects of these possible structural breaks and measurement issues. Also the Committee on the Global Financial System (2009) suggest that a break in the trend in leverage seems to have occurred around 2003-04 as leverage and risk started to build up in less visible ways, as (i) the leverage and risk embedded in structured credit products increased, making traditional measures of balance sheet leverage less meaningful; (ii) assets held in highly leveraged off-balance sheet vehicles increased dramatically; (iii) maturity mismatches, and exposure to funding liquidity risk, increased as off-balance sheet vehicles and some large financial institutions funded a growing amount of long-term assets with short-term liabilities in wholesale markets. The resulting increase in leverage and risk during 2003-07 together with the spread of market-sensitive valuation techniques contributed to an increase in the procyclicality of leverage in the financial system.

[8]Committee on the Global Financial System (2009) concludes that weaknesses of risk-assessment methods led to underpricing of risks which contributed to sharp increases in leverage at banks, especially with large trading book activity. In addition, off-balance sheet vehicles substantially contributed to (invisible) build-up of financial leverage during the current cycle. The measures of bank balance sheet leverage failed to capture this risk. The re-intermediation onto bank balance sheets during the crisis caused traditional balance sheet leverage to expand, ex post, exactly at a time when banks were deleveraging and reducing risk exposures. Furthermore, the time period considered includes the global asset and credit boom and bust that was accompanied by pro-cyclical leverage in the financial system. The large increase in marked-to-market assets on banks' balance sheets implied that any gains or losses were taken on the profit and loss account. During the run-up to the crisis, asset price rises were booked as marked-to-market profits counterbalancing the leverage impact of rapidly growing bank balance sheets; in the bust the reverse happened with eventually large losses hitting capital and increasing leverage.

2.3 Panel regressions

We estimate the elasticity of bank leverage to corporate taxation following a large body of literature focussing on the effect of taxation on firm leverage. We fit a series of panel regressions that take the form:

$$LEV_{it} = \phi LEV_{it-1} + \beta CIT_{it} + \sum_j X_{jit} + v_{it} \tag{1}$$

where LEV is the leverage ratio variable, CIT is the corporate income tax rate, and X_j are control variables such as (log) total asset, total asset squared, profitability, non-performing loan, credit, real GDP growth and inflation to control for country-specific business conditions. The subscripts i and t denote the bank and time respectively. Note that we account also for lagged leverage in the regression to catch the persistence of leverage trough time. The error term v_{it} has the following structure:

$$v_{it} = \alpha_i + \lambda_t + \epsilon_{it} \tag{2}$$

where α_i is the bank-specific fixed effect, λ_t are time dummies used to mitigate the correlation (if any) across individuals (see e.g. [24]), and ϵ_{it} are zero mean homoscedastic uncorrelated errors both along the time series dimension and among individuals. The main interest of the regressions lies in the estimate of the short-run marginal effect of the tax variable on bank leverage, β, and the long-run effect $\beta/(1-\phi)$. The parameters in (1) and (2) are estimated using the generalized method of moments (GMM). Results are presented in the next section.

2.4 Results

Table III shows the results for a series of static and dynamic panel regressions. In any regression we treat profitability as a predetermined variable meaning that current and future shocks are uncorrelated with this variable, but past shocks are not[9]. In difference and system

[9] Future profitability will be affected by current shocks to leverage. A shock to leverage ceteris paribus implies higher funding costs for the bank as creditors will require a risk premium for an increased risk of default due to a lower equity buffer to absorb unexpected losses. Liabilities are gradually refinanced at the higher costs when funding instruments (bonds, loans) mature following information on losses (and the impact on leverage). After refinancing the higher interest cost accrue in the following period. Therefore,

GMM we need to instrument this variable that becomes potentially endogenous when we take differences of both variables and shocks.

The first two columns of Table III reports estimates for the static version of our model. In column (i) we use all explicative variables but non-performing loan and credit, which are inserted in column (ii). The long-run response of CIT to bank leverage is estimated at 0.2, significant at 5% level in both specifications. The signs of the coefficients of the control variables are in line with expectations: larger banks have higher leverage ratios, possibly as creditors expect being bailed out if necessary because of the too-big-to-fail effect reducing the cost of debt funding[10]. Total assets squared have a negative sign reflecting the reducing returns to scale of funding costs benefits. While barely significant, profitability (reflected by average return on assets) has the expected negative sign. Next, bank leverage increases in good times when GDP growth is high, in line with the view of a procyclical leverage[11]. The GDP coefficient is hardly significant though. Inflation is significant in both specifications at the 1% and 5% level respectively. A high share of non-performing loans in the domestic economy requires precautionary capital and thus lower leverage (although the coefficient is not significant). We would expect credit to GDP to have a positive sign reflecting depth and development of a country's financial market. It however switches sign and is not very significant. In both regressions we made use of 25 instruments to deal with pre-determinateness of profitability. To test for the joint validity of the instruments, we use the Hansen test. Table III further reports the p-value of the Arellano and Bond (see [2]) test-statistics that tests zero autocorrelation of idiosyncratic shocks ϵ_{it} and should reveal that

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this impact of a shock to leverage on profitability occurs in future periods and not simultaneously. I.e. the error at time t does not affect profitability at time t but it does affect profitability at time $t + k$.

[10]Note however that not only debt financing is cheaper for large banks. Yang and Tsatsaronis (see [27]) find that banks regarded as highly systemically important by international regulators tend to have a lower average stock return and, hence, also a lower cost of equity finance. Alternative explanations for the high leverage of large banks may be (i) their roles as international trading banks as trading books assets increased most rapidly and (ii) their reliance on internal rating based assessment of risk weighted assets under Basel II allowing lower regulatory capital.

[11]Crotty (see [6]) finds that in good times, (short-term) debt seems relatively cheap compared to (long-term) capital as the costs of illiquidity and loan and trading losses are remote. In good times markets seem to favor a leveraged bank capital structure that generates highest profits. In bad times, though, the costs of illiquidity seem to be more salient, the markets encourage a capital structure with low leverage. Similarly, Yang and Tsatsaronis find that systemic risk is lower near the top of the business cycle and higher around the trough. Adrian and Shin (see [1]) have pointed out that, in a financial system in which the balance sheets of major institutions are continuously marked to market, leverage adjustments appear to be strongly pro-cyclical, thus fueling asset price booms as well as amplifying asset price busts.

some lags of the instruments are invalid in case of rejection. Usually residuals are correlated at lag 1 by construction, but should be uncorrelated at lag 2. No major problems appear in the static regressions.

Next, we turn to a dynamic panel. The estimation of dynamic panel data models requires a careful choice of the estimator in order to avoid spurious results. The cross-sectional dimension is large, we have on average $N = 3,000$ banks observed per year, whilst the time series dimension is small as we observe bank features for $T = 11$ years. In this case removing the fixed effects by the within transformation produces an inconsistent estimator for T fixed, even when N tends to infinity. The solution is typically first differencing both sides of equation (1) and using a GMM estimator. Holtz-Eakin, Newey, and Rosen (see [17]) and Arellano and Bond (see [2]) show how to construct estimators based upon moment equations constructed from lagged levels of the dependent variable and the first difference of the errors (difference GMM estimator). In cases where the dependent variable is very persistent, i.e. ϕ is close to 1, lagged values of the explicative variables are usually weak instruments. Leverage is very persistent over time[12]. Arellano and Bover (see []), and Blundell and Bond (see [3]) proposed additional moment conditions in which lagged differences of the dependent variable are orthogonal to levels of the disturbances.

To have an idea of the persistence of leverage in our sample we use the Ordinary Least Squares (OLS) estimator for equation (1), and the fixed effect estimator obtained removing the individual means on both side of (1). Both estimators are inconsistent, even when N tends to infinity, but the first is known to give an upward biased estimates of ϕ, while the second a downward biased estimates when N growths. This fact can be used to choose between the difference and system GMM estimators (see Bond [4]). Moreover a value of ϕ that is largely outside the lower and upper bound identified by the two inconsistent estimators is an indication of the failure or weakness of the instruments employed. The fixed effect estimator and the OLS estimator in level, not reported in Table III, give the following estimates:

[12]The persistence of leverage is related to the bank profit optimization strategy. In absence of unexpected losses and profits, banks optimize their capital buffers in view of regulatory requirements and funding costs. Higher leverage allows a higher return on equity as it allows holding more assets per unit of equity. High leverage also increases solvency (and liquidity) risk, increasing costs of both equity and debt financing. Banks leverage aims to optimize the risk-return of a leverage level, considering the riskiness of assets and access to debt or equity finance when needed (and subject to the regulatory minimum). The optimal leverage may change with market risk aversion and risk premia or with changes to regulatory requirements. Also transaction costs reduce the ability to change leverage in the short run.

$\hat{\phi}_{FE} = .41$ and $\hat{\phi}_{OLS} = .88$. The range where we expect the true ϕ to lie is quite large but it indicates however a non-negligible autocorrelation of our leverage data.

The first consistent estimator we employ is a two-stage least squares (2SLS) applied after having differenced equation (1). As can be seen from column (iii) the estimate of the autoregressive coefficient is below 0.41, indicating efficiency problems. We therefore experiment with the difference GMM estimator, which in theory should be more efficient (not reported in Table III) but results did not improve.

[insert Table III here]

Columns (iv)-(vii) make use of system GMM. Results are more in line with those we expect. In column (vi) we use data starting in 2004 when Basel II rules started to take effect. Results are close enough to those obtained using also previous years. From (iv) to (vi), the long-run effect of CIT on leverage is estimated at around 0.3. Note that results do no change with post-2004 data. In column (vii) as we leave German banks out of the sample, the long-term effect remains positive but drops to 0.07 and is no longer significant. The sensitivity of the results to the inclusion of German banks may be related to the relatively large variation in CIT in Germany over the period, between 39.6% and 29.8%, and the simultaneous large decline in leverage of mostly smaller German banks, whereas in a number of other countries the CIT rate did not change or barely changed. Note also that the exclusion of German banks halves the sample size.

Our results confirm findings in recent emperical literature and support the idea that ending the preferential tax treatment of debt could be a promising avenue to reduce risky leverage of banks and thus reduce the vulnerability of the banking system to future shocks. In the next section we quantify the potential impact of policies addressing the debt bias on financial stability and public finance losses in systemic crises.

3 The impact of corporate tax reforms on public finance costs of financial crises

To quantify the impact of tax reforms on public finance losses we resort to a micro-simulation model that makes use of individual banks' balance sheet data to simulate banks' aggregated distribution of losses in a banking crisis.

We vary the banks' capital structure according to changes in the corporate income tax regime. The next section describes the methodological foundation of our model.

3.1 A Vasicek-based micro-simulation model of systemic banking losses

To generate the losses that banks face in case of default of its obligors, we consider a stylized banking sector where banks are exposed only to credit risk[13] and are fully compliant with the Basel II Internal Ratings-based (IRB) framework. The intuition of the model is straightforward. Banks applying the Basel II IRB methodology report their Minimum Capital Requirement (CR) based on the risk-weight functions developed by the Basel Committee on Banking Supervision (BCBS). Taking the CR reported by the banks in their annual reports and the parameters calibrated by the BCBS, we can numerically invert the Basel II IRB Risk Weight Function to obtain the average implied probability of default (PD) of the banks' asset portfolios. As the other parameters are set, the PD determines the loss distribution of a bank. Then, we use the derived loss distribution in Monte Carlo simulations, drawing random realizations of (unexpected) losses for the banks and subtracting these from the banks' capital to obtain capital shortfalls and defaults. We assume that a bank defaults when its losses (L) exceed the sum of expected losses (EL) and total regulatory capital (K):

$$L > EL + K \tag{3}$$

where the expected losses are given by the Losses Given Default (LGD) multiplied by the probability of default of the bank and total regulatory capital is the sum of the capital requirement (CR) plus excess capital (EK). To quantify the loss distribution at time t, assume that the bank portfolio associated with losses L is made up of n identical loans with time to maturity $T - t$, and probability of default p. So that $L = \sum_{i=1}^{n} w_i L_i$, $\sum_{i=1}^{n} w_i = 1$, and L_i the loss associated to the i-th loan. Assume further that the i-th loan value A_{it}

[13]Banks must comply with capital requirements not only for their lending activity and credit risk component, but also with capital requirements that derive from market risk, counterparty risk, operational risk, etc.

evolves according to the Geometric Brownian motion:

$$dA_{it} = \mu A_{it} dt + \sigma A_{it} dW_{it}$$

where A_{it} is the asset value, $W_{1t}, W_{2t}, \cdots, W_{nt}$ are equi-correlated Wiener process, i.e. $E[dW_{it} dW_{jt}] = \rho$, for any $i, j = 1, 2, \cdots, n$, $i \neq j$. Vasicek (see Vasicek [29, 30] shows that under these assumptions the asymptotic ($n \to \infty$) cumulative distribution of the portfolio losses is given by:

$$\alpha = \Pr(L \leq x) = \Phi\Big(\sqrt{\frac{1-\rho}{\rho}}\Phi^{-1}(x) - \frac{1}{\sqrt{\rho}}\Phi^{-1}(p)\Big)$$

where $\Phi(\cdot)$, is the cumulative normal distribution function. From the equation above we can derive the losses that are expected to exceed the α-quantile:

$$L = LGD\ \Phi\Big(\sqrt{\frac{\rho}{1-\rho}}\Phi^{-1}(\alpha) + \frac{1}{\sqrt{1-\rho}}\Phi^{-1}(p)\Big) \tag{4}$$

Notice that the assumption of equi -correlated assets implies that the risk implicit in any asset can be seen as the (weighted) sum of a common and an idiosyncratic factor. Equation (4) shows that in a portfolio made up of a large number of small exposures, idiosyncratic risks associated with individual exposures tend to cancel out one-another and only systematic risks have an effect on portfolio losses (see Gordy [12]).

Now the only unknown parameters that enter (4) are p the probability of default of the loan portfolio, ρ the correlation between obligors and LGD Losses Given Default. We follow De Lisa et al (see [7]) to infer p by inverting the Basel II IRB formula (see Basel Committee on Banking Supervision 2005, 2006, 2010, and 2013) that express capital requirement CR as a function of the quality of the bank obligor portfolio. In fact, in Basel II the capital requirement for a given bank is given by:

$$CR = \sum_i w_i CR_i$$

where CR_i, the minimum capital requirement for exposure i with amount w_i, is determined using (3) and (4) and adjusting for time to maturity (M_i) of the exposure:

$$CR_i = \frac{1 + (M_i - 2.5)B_i}{1 - 0.75B_i} 1.06 \left[LGD \; \Phi\Big(\sqrt{\frac{\rho_i}{1-\rho_i}}\Phi^{-1}(.999) + \frac{1}{\sqrt{1-\rho_i}}\Phi^{-1}(p_i)\Big) - LGD \; p_i \right] \tag{5}$$

In the equation above, we follow the settings in the Basel capital adequacy framework. B_i equals $[0.11852 - 0.04578 \log(p_i)]^2$, $LGD = 0.45$, and ρ_i, the asset correlation, is function of the probability of default p_i:

$$\rho_i = 0.12 \; \big(2 - \frac{1 - e^{-50 p_i}}{1 - e^{-50}}\big)$$

The last formula reflects the intuition that the higher the probability of default for exposure i, the higher the idiosyncratic risk, the lower the correlation between assets. Since we observe only the overall capital requirement CR we compute the average probability of default p as the value that inserted into (5) gives CR[14].

3.2 Simulating losses: the baseline case

To generate aggregate losses we apply the theoretical framework described in the previous section. We rely on a sample of around 2800 banks covering all 27 EU countries as the end of 2012.

The steps are as follows:

Step 1: the implied obligors' probability of default p of the portfolio of each individual bank is computed inverting equation (5) numerically, using total minimum Capital Requirement (CR) computed according to Basel II setting $CR = 0.08RWA$.

Step 2: to generate losses for any individual bank $j = 1, 2, \ldots$, we treat $\Phi^{-1}(\alpha_j)$ in (4) as normal variate

$$\Phi^{-1}(\alpha_j) = \rho^{1/2} \; \psi + (1-\rho)^{1/2} \; u_j \tag{6}$$

where ψ is a common factor and u_j is bank specific. Both ψ and u_j are standard normal

[14]All paramenters are set to their regulatory values as in the fundamental IRB approach. Moreover the factor 1.06 is used to adjust the RWA values according to the Basel Committee on Banking Supervision (see Footnote 11 of paragraph 44 in http://www.bis.org/publ/bcbs128b.pdf)

variate. In the baseline case ρ is set to 0.5[15].

From Equation 6 we draw $\Phi^{-1}(\alpha_j)$ and we use these draws in Equation 4 to generate losses.

Step 3: the simulated losses L_{ij} (see Equation 4) are used to establish which bank fails according to (3), i.e. a bank defaults when simulated obligor portfolio losses exceed the sum of the expected losses and the total regulatory capital.

Step 4: for each bank we estimate the potential public finance (PFC) costs as the sum of losses in excess of capital (from step 3) and potential recapitalization needs:

$$PFC_{ij} = \max(0, L_{ij} - K_j + 8\%RWA_j) \; i = 1\ldots, G; \; j = 1, 2\ldots, \tag{7}$$

An aggregated distribution of losses for the whole system is obtained by summing the Equation 7 over all banks in the system. Notice that we do not consider scenarios in which bond-holders are bailed-in, or safety-nets (resolution fund, deposit guarantee scheme) covering part of the losses.

Steps 1-4 provide the banking system loss distribution as implied by actual (2012) bank balance-sheets. Notice that bank losses generated by the model implies a loss distribution with 99.95% Value at Risk (VaR) which is of the same order of magnitude of the losses incurred by the EU banking system in the period 2008-2012. We therefore focus on the 99.95-quantile when analysing the effect of different scenarios of changes to the debt bias in taxation on capital.

Table 4 shows the baseline public finance costs at the 99.95-quantile for the six countries (Germany, Spain, France, Italy, Netherlands and United Kingdom), both in billion euros (based on the sample) and in percent of total assets (% TA). These public finance costs vary from 0.8% TA in Italy to 4.9% TA in Spain. The large dispersion is mainly caused by the differences in the riskiness of the asset portfolio as reflected in the RWAD (RWA/TA), and the amount of capital available to absorb losses.

[insert Table IV here]

[15] This choice is based on Sironi and Zazzara (2004). A discussion and a sensitivity check of this assumption can be found in De Lisa et al. (2011).

3.3 Scenario 1: CIT reduction

In our first policy scenario, we estimate how much the baseline losses affecting public finances would be lowered by reductions in the CIT rate in the order of 1 to 10 pp. This may reflect the effects of an actual reduction of the CIT or a policy measure that partly reduces the effect of the debt bias. We introduce the effects of changes to the debt bias in taxation on capital (ΔK) considering that the leverage is the mirror image of the capital to total assets ratio: $(EK + CR)/TA = 1 - LEV$. We use estimates of the long-run elasticity of bank leverage to corporate income taxation ($\beta/(1-\phi)$) to adjust the excess capital held by banks for different scenarios of reductions in CIT (ΔCIT) as follows:

$$\Delta EK = \frac{\beta}{1-\phi} \Delta CIT \times TA \tag{8}$$

The changes to excess capital above the capital requirement differs across banks, as capital requirement is measured against risk-weighted asset and not total assets, and the RWAD, of total assets differs significantly across banks. Based on the survey of Table 1, we look at simulations of a conservative range of long-run effects of corporate income tax on bank leverage of $\beta/(1-\phi) = [0.05, 0.20]$, considering the uncertainty surrounding the empirical estimates.

Then we repeat the simulations steps 2-4 assuming an increase of capital for any bank of the sample as prescribed by (8). We adjust banks' balance-sheet leverage by replacing debt-financing by capital, for reductions in the corporate tax rate between 1 to 10 pp applying the range of long-run elasticities$\beta/(1-\phi)$. Then we rerun our micro-simulation model repeatedly to obtain bank losses for the set of combinations of CIT reductions and long-run elasticities. The results are reported in Figure 2.

[insert Figure 2 here]

We find that substantial reductions of public finance costs for all countries can be achieved by a reduction of the corporate tax bias equivalent to a reduction in CIT of 10 pp. Reductions in public finance costs are in the range in the range of 10 to 20 pp even in the case of a small long-run effect $\beta/(1-\rho) = 0.05$.

3.4 Scenario 2: eliminating the debt bias in taxation

In this section we gauge the reduction in public finance losses in case the tax debt bias would be eliminated. Reforms that can eliminate the debt bias in corporate taxation include: (i) Comprehensive Business Income Tax (CBIT) that removes the deductibility of interest payments, thus placing debt on a level footing with equity; and (ii) the Allowance for Corporate Equity (ACE), that allows banks/companies to deduct from their taxable profits their interest payments plus an amount equivalent to what they would have to pay their shareholders in interest if all the company's equity were debt[16]. To gauge the effects of an elimination of the debt-bias in CIT on public finance costs in systemic banking crises, we proxy the effect of measures to abolish the tax bias by the technical assumption that the CIT rate is reduced to 0, assuming a linear relationship between CIT and leverage. Again, we show the results for a long-term CIT effect on leverage in the range $\beta/(1-\phi) = [0.05, 0.20]$ [17]. In addition, we also use the results of a study by Schepens (see [25]) on the Belgian ACE that was introduced in 2006, which partly eliminated the debt bias. Schepens considers only the effect over a limited time-period, which may not fully reflect the long-term CIT effect. We use Scheepens estimate of a reduction in banks' leverage ratio by on average 0.91 pp due to the ACE, i.e. an increase in the capital to total assets ratio of 0.91%. The resulting estimated reduction in financial crisis losses that fall on public finances are presented below in Figure 3.

When we consider the effect on bank leverage of an ACE using the estimate by Schepens, we find that bank losses that fall on public finances are reduced in the range of 17 to 34% compared to the baseline. Using the estimates of the long-run effects of CIT on leverage we find even higher reductions in public finance costs, in excess of 90% if the CIT-coefficient would be 0.20. For a conservative CIT elasticity of 0.10, public finance losses could be reduced by 44 to 77%. The degree to which the local estimations in the regression analysis can be extrapolated to out-of sample changes in the CIT rate of 23 pp (for UK) to 34 pp (for France) remains an issue to consider, but Schepens' coefficients may be considered lower bounds considering that his estimated effects of the Belgian ACE are only partial, as he

[16] There are also alternative solutions such as corporate cash-flow taxation (see Fatica et al. 2013).

[17] Mimicking a removal of the corporate debt bias by reducing the CIT rate to zero is justified here by the fact that we are only interested in the effects of the debt bias on the capital structure of the banks. The debt bias is linked to the value of the debt shield, itself proportional to the corporate income tax rate.

only captures short-run effects and because the Belgian ACE does not fully eliminate the debt bias (notably because of caps). Considering the high baseline level of losses, Spain would benefit from the largest loss reductions in terms of %TA or billion euros. Due to the relatively high-risk asset portfolios (high RWAD), Spanish banks' losses remain elevated though also after elimination of the debt bias in taxation.

[insert Figure 3 here]

3.5 Scenario 3: differentiating capital-tight and capital-abundant banks

As discussed in Section 2.1, different studies report heterogeneity across banks as regards the effect of CIT on leverage. Several studies look into differences in size or in the buffer of capital with respect to the minimum capital requirement. There is no consensus on the importance of the heterogeneity of the CIT effect to bank size or regulatory capital buffer. Keen and De Mooij (see [8]) find no significant effects of CIT on leverage for large banks and for banks that are close to the CR. They suggest that these effects are related as larger banks tend to hold smaller buffers. Schepens (see [25]) however finds that the Belgian ACE has been most effective in reducing banks Z-scores for capital-tight banks[18].

To see to what extent the results of the previous sections are robust to heterogeneity across banks, we split the sample into two groups to reflect the different sensitivity to changes in CIT of capital-tight and capital-abundant banks. The cut-off is the sample (whole 27 EU countries) median of the solvency ratio ($\frac{Cap}{\mathrm{RWA}}$ after QIS adjustment for RWA and capital[19]). Figure 4 reports the share of capital abundant banks and the share of total assets in capital abundant banks in the countries that we consider. It shows that in Spain the share of capital-abundant banks is quite small and so is the share of their total assets; more precisely the share of total assets in capital-tight banks is around 77% in Spain. In the Netherlands

[18] Z score is a measure of distance to default. It measures the losses required to wipe out a bank's equity capital. It is defined as $log[(K = A + ROA)/I_{ROA}]$, where I_{ROA} is the standard deviation of return on assets ROA.

[19] We adjust the reported Basel 2 RWA and capital to take into account future changes introduced by Basel 3 to RWA definitions and requirements, better reflecting actual risk. Average EU results of the 2012 European Banking Authority Quantitative Impact Study (QIS) are used for the adjustment.

and the UK, the share of capital-tight banks in total assets is negligible, while Italy, France and Germany have between 15 and 20% of total assets in capital-tight banks.

[insert Figure 4 here]

We simulate the effects of eliminating the debt bias showing a range of low coefficients for the CIT-effect on leverage for capital-tight banks $\beta/(1-\phi) = [0.0, 0.10]$ and a larger range including higher coefficients for capital-abundant banks $\beta/(1-\phi) = [0.0, 0.30]$.

Figure 5 shows the result for the individual countries of the sample. The difference in profiles is remarkable and due to substantial differences in capital buffers and RWAD of total assets of the banks across countries. For instance, in the UK and the Netherlands, the iso-loss curves are horizontal, as the large majority of assets are in capital-abundant banks. This implies that the coefficient on capital-tight banks is not relevant for the reduction in public sector losses across the banking system. If the average CIT elasticity of leverage for capital-abundant banks would be in the range $(0.10, 0.15)$, public finance costs of banking crisis could be reduced by 80% or more if the debt bias in taxation would be eliminated in these countries. In Spain, the opposite holds and the elasticity for capital tight banks drives the changes in losses. But even if the elasticity for capital tight banks would only be around 0.05 in these countries, public finances costs of banking crises could still be reduced by half. In Germany, France and Italy, the results are more mixed and both CIT elasticities of leverage for capital-tight and capital-abundant banks drive the outcomes, with Italy's losses more dominated by the CIT-elasticity of leverage for capital-tight banks and Germany and France more by that for capital-abundant banks.

[insert Figure 5 here]

3.6 Scenario 4: accounting for endogenous risk increase on the asset side

In the above simulations the asset portfolio of the banks is always considered exogenous and held fixed to its reported balance-sheet value. The capital structure (or liability side) of the bank balance sheet may however not be the only item affected by the debt bias in CIT. Several studies indeed suggest that portfolio risk on the asset side may indirectly be sensitive to taxation. Devereux (see [10]) presents a theoretical framework suggesting that an increase in capital due to a reduction in the debt bias of taxation induces banks to increase risk on the asset side, as the increased capital provides room under the Basel regulatory framework and in particular the Tier I capital ratio. Banks would thus adjusts the RWAD of their asset portfolio in response to an increase in capital. This mechanism could undermine the benefit of higher capital by greater asset risk. Total risk relative to capital could be expected to be as large as before the reduction of the debt bias of taxation. The degree to which this theoretical argument holds depends on the extent to which all banks target an internal bank-specific risk-weighted capital ratio (or a target buffer to the minimum CR), such that any increase in capital is matched by an increase in asset portfolio risk. There is a strand of literature that confirms a positive relationship between short- and long-run adjustments of the capital structure and asset risk; the strength of the relation however varies and does not seem to hold in full for all banks. Horvath (see [18]) provides empirical estimates using a sample of $17,000$ banks in 71 countries, he finds a negative long-term effect of CIT on RWAD in the range $(0.2, 0.7)$. If confirmed this effect implies very large changes in the bank asset portfolio as a reaction to the elimination of the debt bias.

The high end of the range would for instance imply an increase in the RWAD of 28 to 58% in case of elimination of the debt bias of CIT. Slow adjustment (only 15% adjustment per year of the gap between target and actual RWAD in the GMM) indicates high sensitivity of changes in the sample or control variables. Indeed, excluding US banks from the sample, Horvath's estimate of the effect of CIT changes to RWAD drops from .70 to .16 (and becomes insignificant). As Horvath's findings provide the best available estimate that we can use in our analysis ,we take on board his findings and we run another set of simulations where bank losses are generated for various combinations of long-term effect of CIT on leverage and on RWAD. As in the previous simulation we consider a long-term effect of CIT on leverage in the range $(0., 0.2)$ and using Horvath results we set the long-term effect of CIT on RWAD in the range $(0, 0.2)$ that is broadly in line with his findings for non-US banks.

Figure 6 provide the simulation results in detail. It shows similar results for all countries. The positive effects on financial stability of eliminating the debt bias of CIT are only reversed . The benefits in terms of lower public finance costs of financial crises are only reversed for rather extreme combinations of the long-term CIT-effects on leverage and RWAD: if the long-term CIT effect is very low (below 0.03), and the RWAD very high in the range (0.15,0.20).

For CIT-effects on leverage at the lower end of the ranges found in recent literature around 0.10, the loss reduction ranges from 40 to 70% loss reduction across countries, except for the Netherlands were it drops to around 30% for RWAD effects at the upper bound of the range.

[insert Figure 6 here]

4 Conclusion

The findings in this paper provide empirical evidence that reducing the debt bias in corporate taxation for banks can significantly reduce public finance costs of financial crises. The analysis raises the question why tax policies continue to discourage equity financing in many countries while regulatory policy is tightened to increase it. The panel regressions support recent findings in empirical literature suggesting that the abundant evidence on the debt bias of taxation for non-financial corporations can be extended to banks. As the econometric evidence on the size and significance of the effect of CIT on bank leverage remains sensitive to the data sample and model setting, further analysis would be insightful though. The (planned) introduction of measures to reduce the debt bias in taxation in a number of countries may provide for a natural experiment as new data becomes available over the next years. An important conclusion of the analysis in this paper is that even if the tax elasticity of bank leverage is at the lower end of the ranges found in recent literature, eliminating the debt bias in CIT could lead to a very sizable reduction in public finance costs of a banking crisis. These results hold when asset portfolio risk is allowed to increase in response to elimination of the debt bias of CIT, as benefits remain sizable for a large range of the parameter space. The findings call for addressing the debt bias in taxation by e.g. Allowance for Corporate Equity (ACE), an Allowance for Bank Equity (ABE) or a comprehensive business income tax (CBIT).

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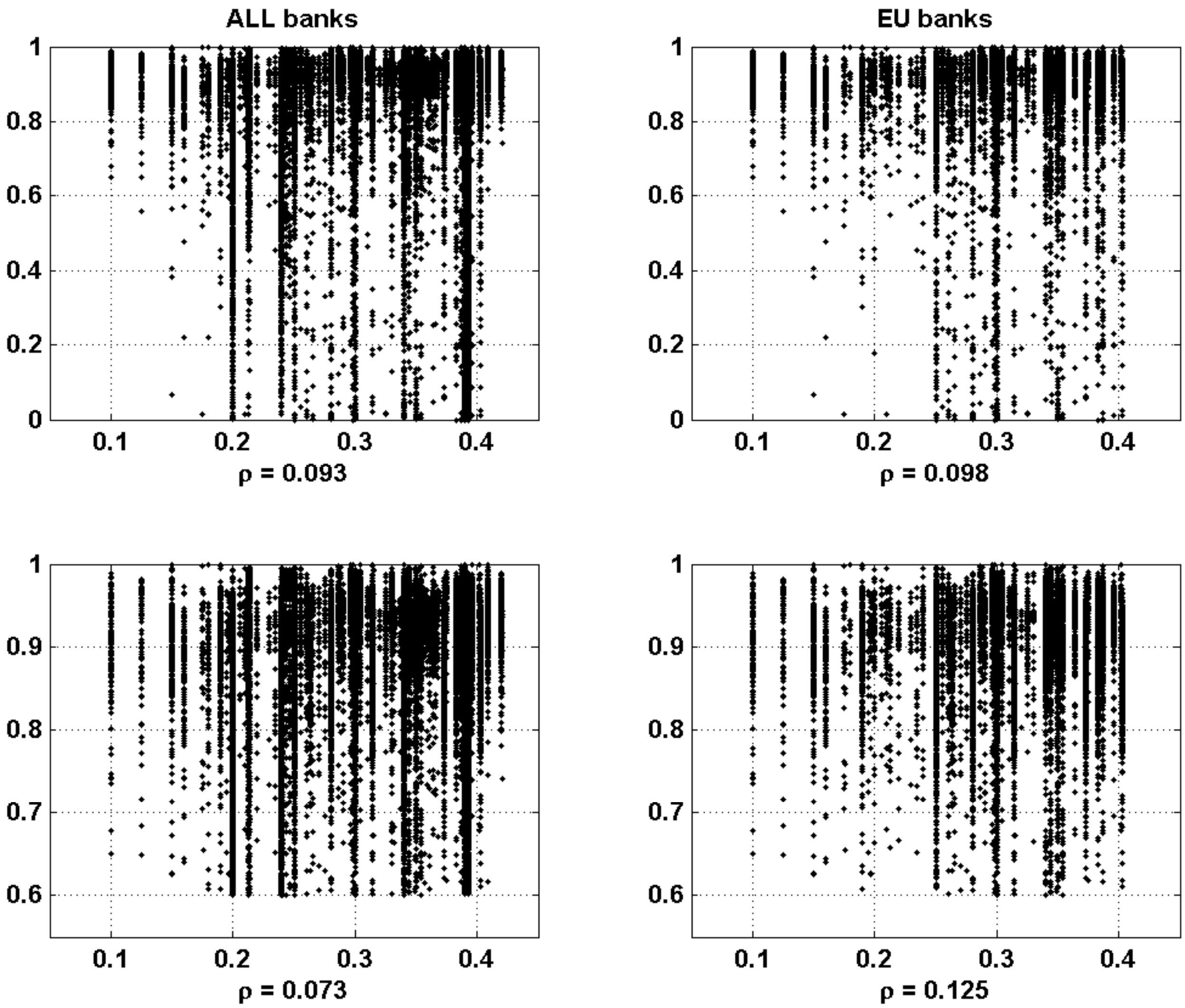

Figure 1: Left panels show scatter diagrams of CIT versus leverage for full sample (incl non-EU banks), without (top) and with (bottom) lower bound on the leverage ratio while right panels show similar scatter diagrams for EU sample

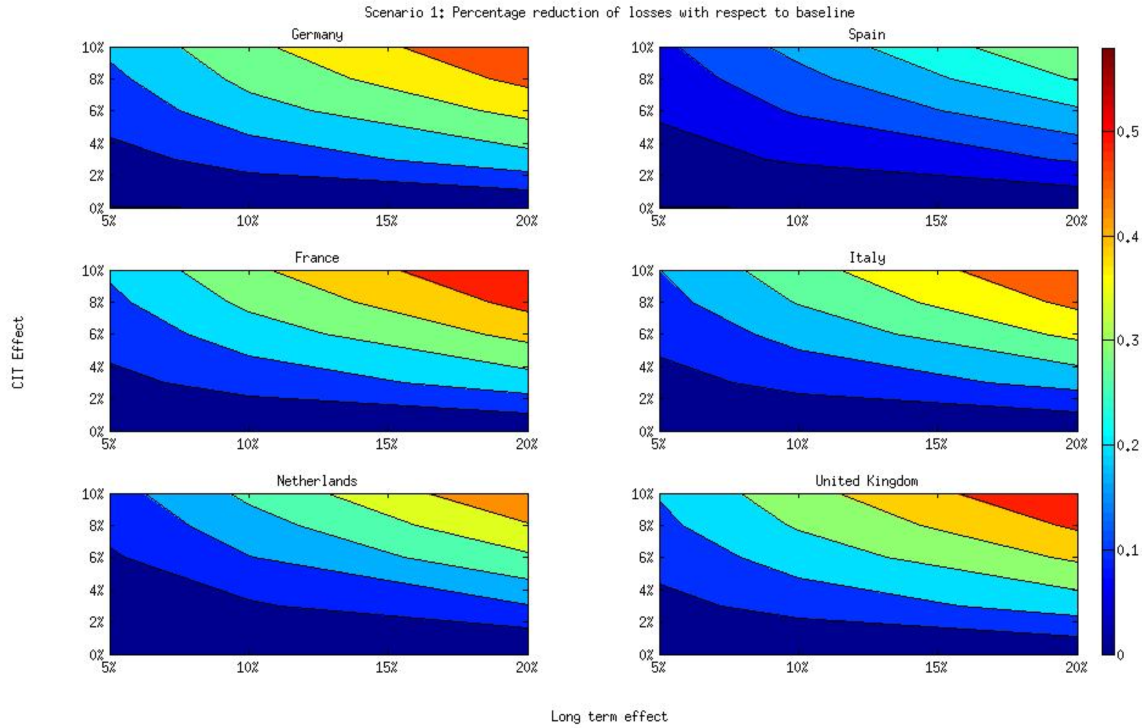

Figure 2: Percentage reduction with respect to baseline of Public Finance Costs of a Systemic Banking Crisis Considering Reductions in CIT (y-axis) for Different CIT Effects on Leverage (x-axis), %TA

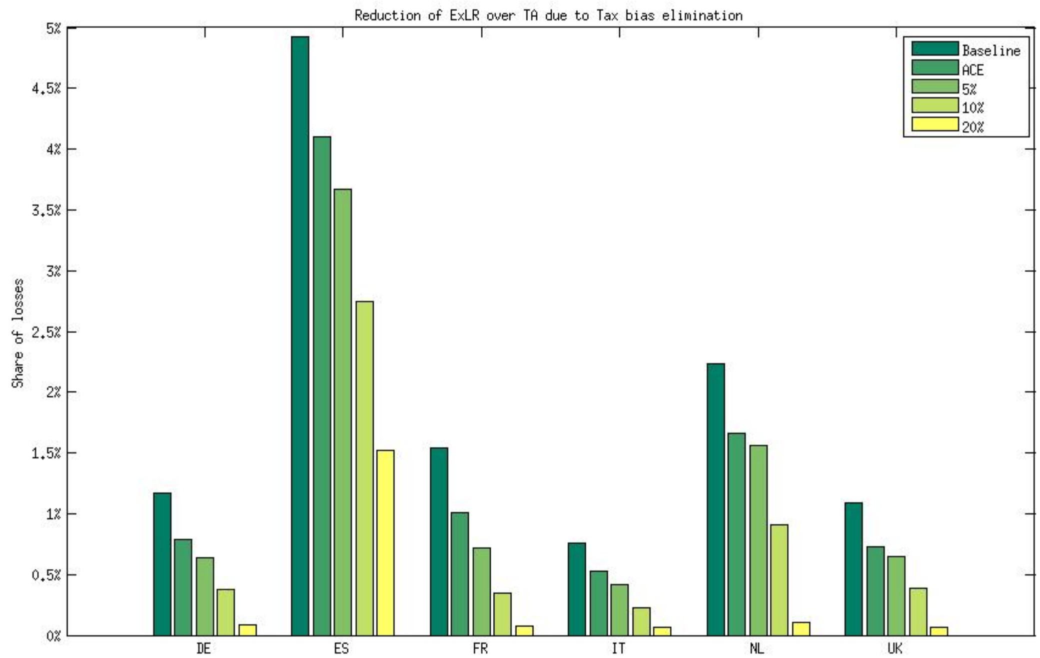

Figure 3: Percentage reduction with respect to baseline of Public Finance Costs of a Systemic Banking Crisis Considering Elimination of the Debt Bias for different CIT effects on leverage, % TA

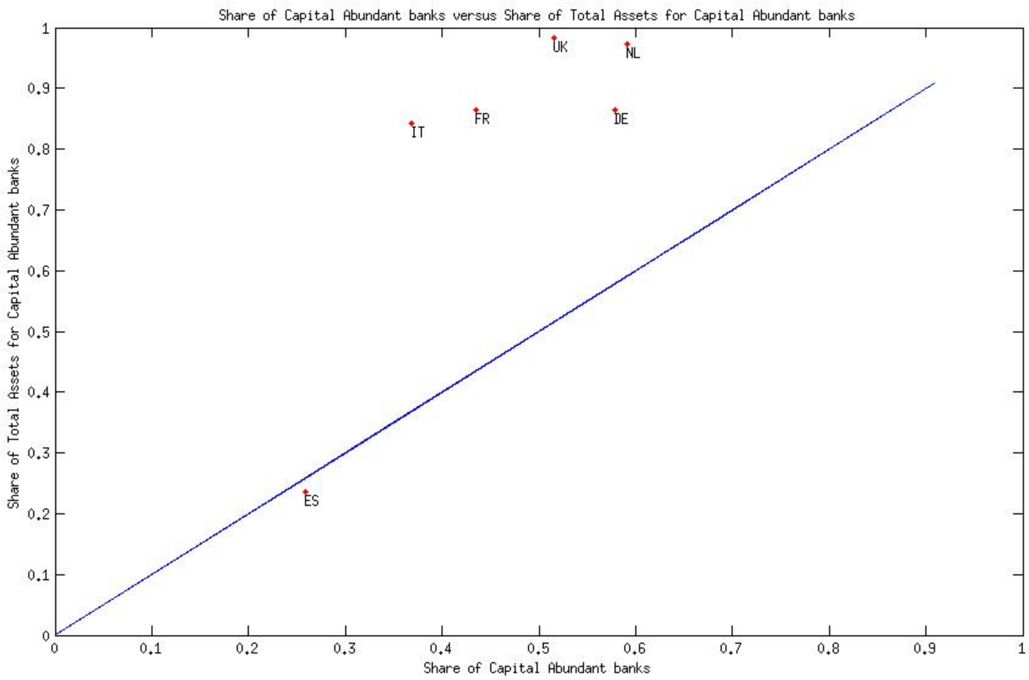

Figure 4: Capital Abundant Banks (Share of Banks versus Share of Total Assets)

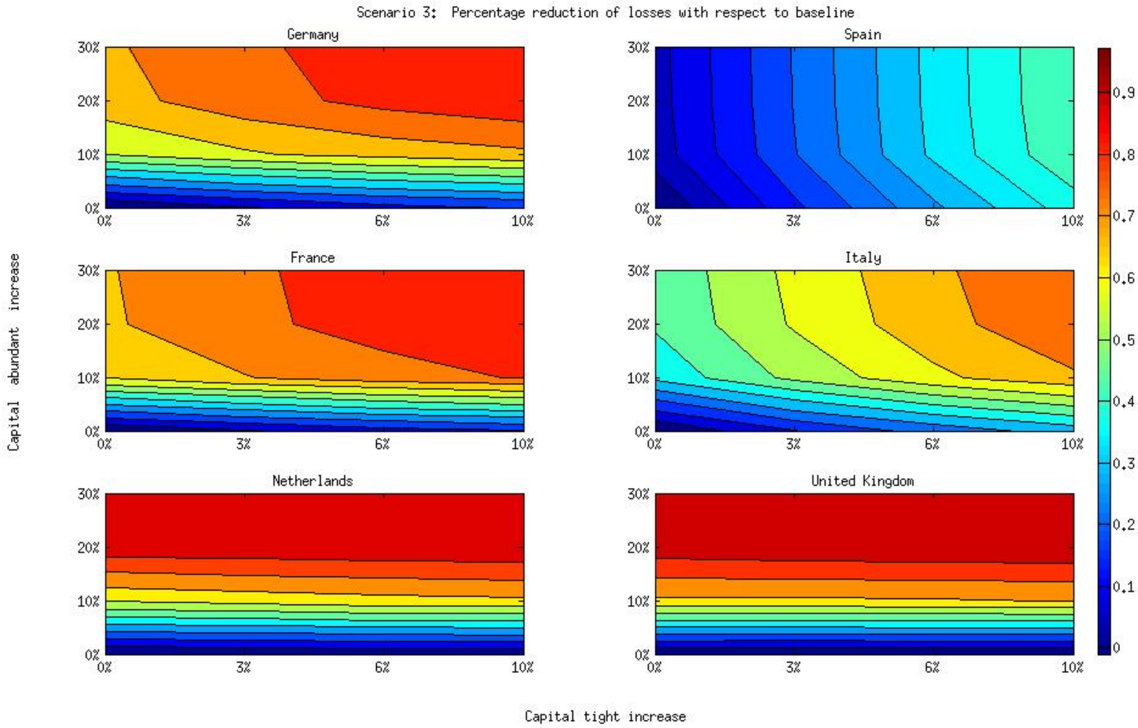

Figure 5: Perecntage of reduction with respect to baseline of Public Finance Costs of a Systemic Banking Crisis Considering Different CIT Effects on Leverage for Capital-Tight (x-axis) and Capital-Abundant Banks (y-axis), % of TA

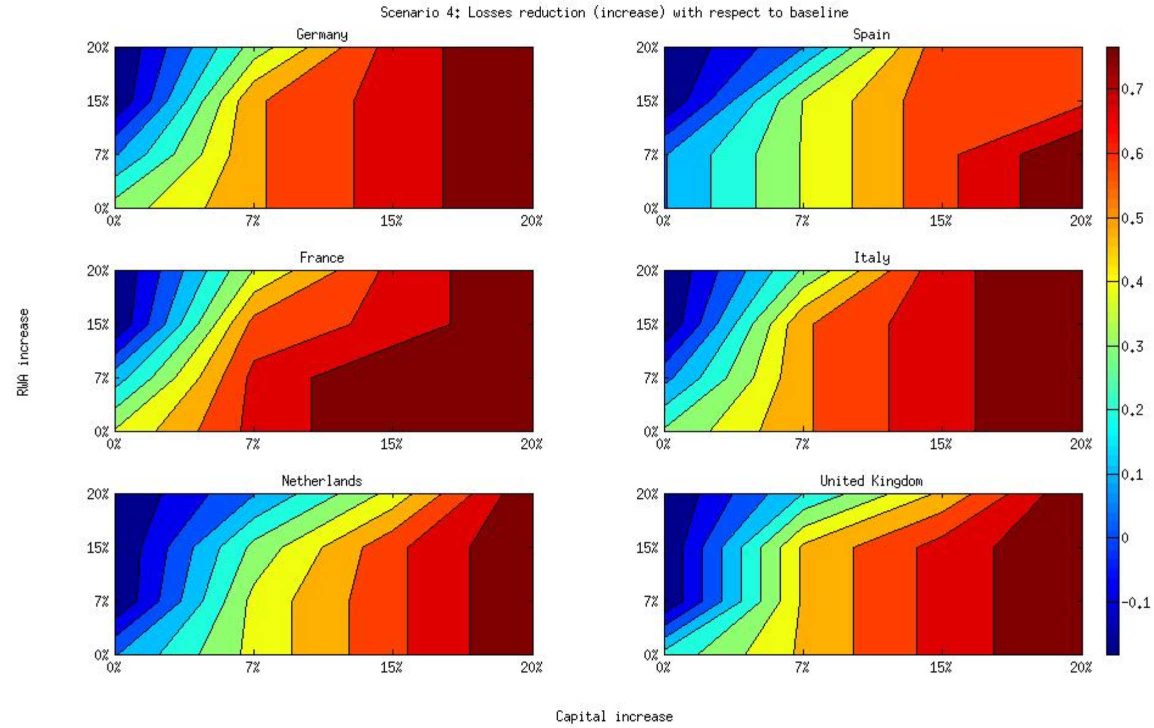

Figure 6: Percentage of reduction (increase) with respect to baseline of Public Finance Costs of a Systemic Banking Crisis Considering Different CIT Effects on Leverage (x-axis) and RWA-density (y-axis). The dark-blue region in the top-left corner of each graph identifies potential increases

Table I

Overview of literature on CIT effect on bank leverage

Estimates provides ranges of the long-term effect of corporate income taxes on bank leverage when available.

Authors	Year	Estimates	Dataset	Specific findings
Keen and de Mooij	2012	$(0.15, 0.27)$	2001 -2011 82 countries 14,377 banks	capital-tight and large banks are less responsive
Gu et al.	2012	$(0.25, 0.34)$	1998 - 2011 558 subsidiaries 86 largest banks	debt shifting behavior of banks due to tax differences across countries has a larger effect on the capital structure than the traditional debt bias
Horvath	2013	$(0.08, 0.14)$	1997 - 2011 71 countries 17,003 banks	capital-tight banks are less responsive; long-term CIT effect on RWA from 0.2 to 0.7
Hemmelgarn et al.	2013	0.10	1997 - 2011 87 countries 15,000 banks	
De Mooij et al.	2014	$(0.14, 0.31)$	2001 -2009 82 countries 13,356 banks	large banks are less responsive
Langedijk et al.	2014	$(0, 0.33)$	2001 -2011 27 EU countries 3000 banks	see section 2.3

Table II

Summary statistics for the variables included or tested in the panel analysis

LEV is the leverage ratio in pp, *CIT* is the corporate income tax rate in pp, log-TA ist he logarithm of total assets, ROA is returns on average assets in pp, RWAD is risk weighted asset density in pp,GDP is the annual GDP growth rate in pp, INF is the infaltion rate in pp, NPL stands for non-performing loans, CRED is the credit variables as described above, and RIR is real interest rate in pp. Counts represents the total number of observations, min is the minimum value, p_5 and p_{95} are the 5-th and 95-th percentiles, max is the maximum value and sd is the standard deviation.

	counts	min	p_5	median	p_{95}	max	sd
LEV	32,833	60	82	93	96	99	5
CIT	32,833	10	25	34	40	40	6
log-TA	32,833	-1.1	4.0	6.3	9.5	14.5	1.7
TA^2	32,833	0.0	15.9	39.3	91.0	209.2	25.1
ROA	32,718	-49.5	-0.1	0.3	1.7	36.6	1.2
RWAD	10,789	0	.00	.02	1.15	57	1.3
GDP	32,833	-19.5	-5.3	1.5	4.0	10.6	2.7
INF	32,833	-1.7	0.2	2.0	3.6	34.5	1.6
NPL	32,595	0.1	0.8	3.4	9.5	21.2	2.5
CRED	32,811	13	89	131	197	330	32
RIR	24,861	-2.2	1.0	2.6	4.3	12.1	1.2

Table III

Estimates of the long-term effect of corporate income tax on bank leverage

Columns (i) and (ii) reports results for static panel regressions, (iii) employs the 2SLS estimator, (iv)-(vii) employ the system GMM estimator, (vi) uses post-2004 data, (vii) leaves German banks out of the sample. Standard errors between parenthesis; *, **, and *** indicate significance level at 1, 5, and 10% respectively; A-B AR(p) is the Arellano-Bond (1991) p-value for lag $p = 1, 2$.

	Static		Dynamic				
	GMM		2SLS	system GMM			
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)
	base	credit control	base	base	credit control	post Basel II	excluding German banks
ϕ			.340***	.778***	.798***	.765***	.812***
			(.051)	(.078)	(.074)	(.081)	(.071)
β (CIT)	.214**	.196**	.031***	.068**	.066**	.078**	.013
	(.095)	(.077)	(.008)	(.032)	(.035)	(.046)	(.029)
$\beta/(1-\phi)$	**.214**	**.196**	.047	**.307**	**.328**	**.332**	.069
log-TA	2.20***	1.86***	10.4***	.27	.26	.26	.27
	(.25)	(.37)	(1.10)	(.19)	(.19)	(.18)	(.19)
TA^2	-.09***	-.07***	-.42***	-.01	-.01	-.01	-.01
	(.01)	(.03)	(.08)	(.01)	(.01)	(.01)	(.01)
ROA	-.42*	-.28	-.34***	-.50***	-.48***	-.43***	-.47***
	(.26)	(.29)	(.08)	(.17)	(.17)	(.18)	(.18)
GDP	1.06*	.11	-.03***	-.44**	.55***	.40***	.28
	(.63)	(.62)	(.01)	(.18)	(.25)	(.22)	(.21)
INF	-.96***	-1.30**	-.03*	-.09	.03	.18	.18
	(.18)	(.59)	(.02)	(.07)	(.07)	(.18)	(.18)
NPL		-.37			.09***	.04	.05
		(.28)			(.03)	(.03)	(.05)
CRED		-.06**			.01**	.005*	.005*
		(.03)			(.004)	(.003)	(.003)
n. of obs.	23,908	23,760	23,730	23,765	23,499	18,525	11,577
n. of instrum.	25	25	15	40	42	36	42
A-B test AR(1)	.00	.24	.00	.00	.00	.00	.00
A-B test AR(2)	.15	.66	.00	.12	.05	.02	.22
Hansen test	.06	.10	.02	.135	.08	.04	.05

Table IV

Simulation of Public Finance Costs of a Systemic Banking Crisis

Baseline losses

Losses are computed on the sample and they are reported in Euro bn. Shares are computed with respect to sample total assets

	DE	ES	FR	UK	IT	NL
Losses	62	75	102	19	29	74
Shares	1.17	4.9	1.5	0.8	2.2	1.1