The Cost of Capital for Banks*

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March 15, 2019

Abstract

Expected returns based on analyst earnings forecasts show that when the tier 1 ratio increases the cost of equity and debt capital for banks decreases whereas total cost of capital remains unchanged. These findings are consistent with the conservation of risk principle (Modigliani and Miller, 1958). Empirically, the disadvantages of equity funding are small; a 10 pp increase in the tier 1 ratio preserves total risk but causes a 2.3% loss of firm value due to the lower tax shield. The loss is equivalent to a 2-8 bps increase in borrowing rates. These findings have important implications for the cost of substantially heightened capital requirements.

Keywords: Bank funding; Cost of equity; Total cost of capital; Leverage effect; Capital buffers.
JEL: D92; G21; G28; L51

*Thanks to Ken Bechmann, Kristian Kjeldsen, David Lando, Lasse Heje Pedersen, Jesper Rangvid, Carsten Tanggaard, and seminar participants at the Danish Central Bank, and FRIC center for their helpful comments. Jens Dick-Nielsen gratefully acknowledges support from the Center for Financial Frictions (FRIC), grant no. DNRF102. The research was initiated while Jacob Gynetelberg was a guest researcher at the FRIC. The views expressed here are the authors' and are not representative of the views of Nordea Group.

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1 Introduction

The costs and benefits of banking regulation are continuously debated. A key issue is if loss absorbing capital in the form of equity is expensive funding for the banks. If equity funding is indeed expensive, then increased capital requirements come at a cost for the banks. The main argument for why equity funding might not be expensive is the capital structure irrelevance theory from Modigliani and Miller (1958). Our main contribution is to empirically quantify if and in what sense equity funding can be considered expensive for banks.

We show that the cost of equity and debt capital is decreasing when the level of equity funding increases. The shift in capital structure weights and the lower cost of debt and equity balance out so that the total cost of capital is indeed independent of the level of equity funding. This result is consistent with the principle of conservation of risk (Modigliani and Miller, 1958). It indicates that investors do not demand a higher return on their combined portfolio of equity and debt when the banks change their capital structure in favour of more equity. In this sense equity funding is not expensive. However, the statement has to be modified in two ways. First, while investors do not demand a higher total rate of return when equity funding increases there is an immediate decrease in firm value from the loss of tax shield. Second, when equity replaces deposits in the capital structure the cost of capital increases for some banks. Looking at the first effect, it is not surprising that the loss of tax shield decreases firm value. Banks likely optimize their capital structure under the given circumstances (see e.g. Duchin and Sosyura (2014)) and forcing them away from this equilibrium then lowers total firm value. We calculate an upper bound on the loss of firm value of 2.3%. In doing this we ignore the benefit from a decrease in expected bankruptcy costs. Another way of understanding the loss of tax shield is to consider the increase in customer borrowing rates which would offset the firm value loss. This is equivalent to looking at the increase in the weighted average cost of capital after taxes (WACC) and assuming that customers would absorb this increase through higher borrowing rates (Kashyap, Stein, and Hanson, 2010). As the WACC increases, banks face less value creating investments, which will hamper the banks' willingness to lend to less profitable customers. This is of special interest to regulators since a negative impact from higher capital requirements on loan activity will result in lower economic activity. We show that the increase in borrowing rates which would offset the firm value loss would be around 2.3-8.5 basis points which is far less than the effect found in Kashyap, Stein, and Hanson (2010) and in Baker and Wurgler (2015).

The other effect to consider is when equity replaces deposits in the capital structure, so that the deposit ratio decreases as much as the equity ratio increases. This substitution leads to higher total cost of capital for the bank and indicates that deposits can be seen as a source of cheap funding. This is most likely because depositors are willing to accept a low deposit rate in return for a liquid-claim (see e.g. Allen, Carletti, and Marquez (2015), DeAnglo and Stulz (2015)) and because of depositor insurance allowing the bank to transfer away some of their default risk. In recent years the general interest rate level has decreased substantially, narrowing the gap between the deposit rate and other interest rates. This has made the effect of deposits on the total cost of capital weaker over time. However, the level of deposits has an even larger effect on the tax shield asset after 2011. This is because the discount rate for the tax shield asset is also substantially lower when interest rates are low, which makes a given level of interest payments more valuable for the banks.

Our paper contributes to the literature on the interaction between the cost of equity capital and capital requirements (Berger, Herring, and Szego, 1995). Miller (1995) argued that the general conservation of risk principle from Modigliani and Miller (1958) should also apply to banks, which is what we confirm empirically. Our findings thus provide support for an analysis of capital requirements using the conservation of risk principle as the starting point (see e.g. Kashyap, Stein, and Hanson (2010), Admati and Hellwig (2013)). Prior studies have not found support for the principle (see e.g. King (2009) and Miles, Yang, and Marcheggiano (2013)). Common for many of the prior studies is that they have used some version of the capital asset pricing model (CAPM) when forming expected returns. We deviate from this approach by using analyst earnings forecasts which should result in estimates which are closer to market expectation (So, 2013). Baker and Wurgler (2015) show that there is a low-risk anomaly for banks in the sense that leverage and beta are positively correlated but realized bank stock returns are almost independent of the beta. Lower leverage resulting in lower beta risk would therefore not decrease funding costs as predicted by the conservation of risk principle. The same low-risk anomaly is even more pronounced in our data sample. However, when we control for asset risk, the riskiness of debt in the capital structure, and use expectations based on analyst earnings forecasts, the low-risk anomaly disappears in the sense that expected returns align with realized returns.

Specifically, we use an implied cost of capital (ICC) commonly used in the accounting literature when forming expected equity returns (see e.g., Claus and Thomas

(2001), Gebhardt, Lee, and Swaminathan (2001), Easton (2004), Ohlson and Juettner-Nauroth (2005)). This measure does not exhibit the low-risk anomaly and predicts realized returns fairly well in our sample. The ICC measure relies on analyst earnings forecasts and So (2013) shows that these forecasts are very close to the actual expectations in the market about future earnings. We use analyst earnings forecasts from IBES over the period from 1993-2016, because this is the period for which the tier 1 capital ratio is available. Our sample includes all US banks and covers a total of 1,758 banks. Since our sample period spans the 2008 financial crisis, we also investigate the impact of direct government support. We find that there is a minor reduction in the cost of capital when the government has a direct equity stake in the bank. This effect is in addition to the effect from the increase in equity capital that comes from the government purchasing shares and thereby decreasing bank leverage (Taliaferro, 2009).

Our study also deviates from previous studies (e.g. Baker and Wurgler (2015)) in that we do not assume that bank debt is risk free. Instead we use the total interest payments made by the bank to calculate an expected return on the debt. We find that the expected debt return is also decreasing in the tier 1 ratio. This suggests that the debt is not risk free and that banks with less leverage also have a lower cost of debt. The finding is also consistent with banks' emphasis on ratings to lower their debt funding costs.

By quantifying the relationship between the cost of capital and the level of equity funding, we can evaluate how an increase in capital requirements would impact the banks' funding costs and firm value. Admati and Hellwig (2013) suggest a tier 1 ratio in the range of 20-30%. Extrapolating from our results and looking at an increase in the tier 1 ratio of 10 percentage points, we find that both the cost of equity and the cost of debt would decrease while the total funding cost would not move significantly. Hence, investors would not on average demand a higher return on their investments. However, there will be an immediate loss of firm value from the reduction of the tax shield. The loss would be around 2.3% when looking over the entire sample period. Restricting the sample period to after 2011 where interest rates are low, the loss would be around 3.0%. While low interest rates decrease the size of the tax discount, they also decrease the riskiness of the tax shield asset which is the dominating effect. These estimates are upper limits in the sense that we ignore the benefits from a reduction in expected bankruptcy costs. The loss in firm value is fairly small considering the very high increase in the tier 1 ratio. If equity replaces deposits in the capital structure, this will modify the impact. The loss of tax shield after 2011 will be lower at around 1.6% of firm value because deposits is a debt category contributing very little to the total interest payment. Finally, the total cost of capital would experience an insignificant increase.

In addition to a requirement on the tier 1 capital to risk-weighted asset (RWA) ratio, US banks also have to fulfil a leverage ratio requirement based on the tier 1 capital to total assets. Admati and Hellwig (2013) argue in favour of the leverage requirement because risk-weighted assets can potentially be manipulated by sophisticated banks. We therefore repeat our analysis replacing the tier 1 capital ratio with the leverage ratio, i.e., tier 1 capital to total assets. The results are robust to this change indicating that both tier 1 to RWA and tier 1 to assets are used by the market for the assessment of risk. We also investigate other measures of bank leverage and find that the results are robust to measures based on tier 1 capital. Our results change slightly when we use book value of common equity in the regression instead of tier 1 capital. This is likely because equity on the balance sheet also contains elements like goodwill and tax deferrals which are not directly linked to the funding of the bank and which cannot be capitalized if the bank is in need of funding. Finally, results are also robust to using the CET1 ratio or the size of bank buffers, where bank buffers are defined as the distance to the bank's individual capital requirement.

Interestingly, there is a difference between small and large banks. When increasing the tier 1 capital ratio or reducing the leverage ratio, smaller banks get a larger discount on their cost of equity and debt compared to larger banks. The effect on the total cost of capital is in both cases neutral. If this is because larger banks are believed to be able to manipulate their tier 1 capital ratio then it seems that they are equally able to manipulate their leverage ratio. We also find that deposit funding is especially cheap or beneficial for the larger banks compared to the smaller banks. This could indicate that the deposit insurance premium is fairly priced for the smaller banks but too cheap for the larger banks.

2 Estimating expected returns

In order to assess the impact of an increase in bank equity capital, we study the relationship between expected returns and leverage for the banks. Expected returns reflect how risky the investors consider the banks to be. A positive change in perceived risk should translate into a higher expected return which requires banks to earn a higher return on capital to satisfy their investors.

In this section, we describe how expected returns on equity, debt, and the total capital are estimated empirically. Throughout the paper, we will use the terms expected returns and cost of capital interchangeably.

2.1 Data

We collect quarterly accounting data from Compustat for all US banks for the period 1984-2016. Regulatory capital ratios are only available as of the fiscal year 1993 but we will need to calculate 10-year average returns on equity for the banking industry which is why we start the sampling period earlier. We identify bank companies in Compustat in the same way as in Fama and French (1997) and Baker and Wurgler (2015) using the 4-digit SIC code for banks and also including bank holding companies (based on the 3-digit SIC code). We augment the accounting data with monthly stock returns and the value-weighted stock market return both from CRSP. For robustness and depth we also collect capital ratios from the bank regulatory database in the years 1996-2014. To get a full sample of this data we manually collect the missing data from the quarterly and annual reports for all of the banks in our sample. From the same reports we also collect the required amount of capital for each bank as demanded by regulators, i.e. the individual bank's various capital requirements. Finally, we add analyst earnings forecasts and long-term growth forecasts from IBES and combine it all into our final dataset.[1]

In our main analysis we use median values of analyst earnings estimates to mitigate the impact of outliers.[2] We perform our estimations combining IBES data available at the first trading day of each month starting in 1994 with the most recently available

[1]Table 1 lists the accounting variables and their names in Compustat. Furthermore, the table also lists variables from CRSP, IBES and other data sources.

[2]We have also conducted the analysis using means instead of medians and the results are both qualitatively and quantitatively unchanged.

accounting data. That is, we use the most recently known values from IBES and the latest available accounting data from Compustat in any given month for any given bank. From Compustat we use the public release date of every quarterly report and align these dates with our IBES dates. To illustrate, assume that bank X released a quarterly financial report on the 5th of January and will be releasing new accounting information on the 5th of April. Assume further that the first trading day of April happens on the 1st of April. In this case, we will estimate the cost of capital on the 1st of April using the most recent publicly available accounting information, that is, the one released on the 5th on January. Once we estimate the cost of capital on the first trading day of May, we will then be using the accounting information as of the 5th of April. For each bank regardless of how their fiscal year runs we will always be using the most up to date publicly available accounting and price data. Using this approach, we avoid making simplistic assumptions as to when financial reports are known and we mimic the information available to analysts and other market participants.

We construct all per share variables for the Compustat data by dividing it with the outstanding shares as reported from IBES. We use IBES shares as the common denominator since earnings forecasts reported in IBES are on a per share basis with the IBES shares as the denominator. This ensures that all of our variables are comparable.

We end up with 1,758 US banks over the years 1993-2016, where the binding constraint is that the banks need to have analyst earnings forecasts in IBES. Finally, we retrieve all of the supporting financial transactions between the US government and US banks following the 2008 financial crisis from the website Propublica. We retrieve both the purchases of individual banks' equity by the US government and the refunds paid from the banks to the government. We collect this information, if relevant, for all of the banks in our sample who existed in either 2008 or 2009. During the turmoil of the 2008 financial crisis, many banks did receive government support, and we only collect the direct support to individual banks.

2.2 Expected return on equity capital

We estimate the expected return on equity following established methods from the accounting literature. In the accounting literature the expected equity return is usually called the implied-cost-of-capital (ICC). Most models of the ICC are constructed using the same basic setup, see e.g., Claus and Thomas (2001), Gebhardt, Lee, and Swaminathan (2001), Easton (2004), Ohlson and Juettner-Nauroth (2005). The ICC is found as the discount rate solving a dividend discount type expression:

$$P_{i,t} = \sum_{n=1}^{\infty} \frac{\mathbb{E}_t[D_{i,t+n}]}{(1 + ICC_{i,t})^n} \tag{1}$$

where $P_{i,t}$ is the market price of equity and $D_{i,t+n}$ is the future cash flows (dividends) of bank i at time t. Thus, we can observe $P_{i,t}$ directly in the market but we have to use some model for determining $\mathbb{E}_t[D_{i,t+n}]$ and different model assumptions will result in different estimates of the implied cost of capital, $ICC_{i,t}$.

A common approach for getting a robust estimate is to compute the ICC using several different methods and then taking the equally-weighted average across them. Mohanram and Gode (2013) show that averaging across several models yields more accurate estimates with lower measurement errors. The main estimate of expected returns on equity capital in this study is therefore the average of the four most commonly used ICC measures,[3] which are those of Claus and Thomas (2001), Gebhardt, Lee, and Swaminathan (2001), Easton (2004) and Ohlson and Juettner-Nauroth (2005).

Since the ICC approach utilizes information from analysts, potential biases in analyst estimates will have a direct impact on the estimates of the ICC. To solve this problem two approaches have been proposed in the literature. One approach is to adjust the earnings forecasts by the predictable errors made by analysts, see e.g., Easton and Sommers (2007) and Mohanram and Gode (2013). The other approach is to forecast earnings directly using a forecasting model as done in Hou, van Dijk, and Zhang (2012). The latter approach supposedly has two advantages. First, it allows one to obtain earnings estimates, and ultimately ICC estimates, for banks that are not covered by financial analysts, and, second, it avoids biases embedded in analyst estimates. Even though both of these methods have shown some (mild) success in reducing biases in the ICC, the important question for our analysis is if the ICCs derived in this fashion better reflect investors' ex-ante expectations. So (2013) uses an earnings forecast model very similar to the one from Hou, van Dijk, and Zhang (2012), and finds that investors rely heavily on analyst expectations when forming their own expectations about firm performance. In fact, investors rely so heavily on analyst estimates that it is possible to make a trading strategy buying or shorting those stocks that show a large discrepancy between the model forecasts and analyst estimates (So, 2013). This indicates that the calculated ICC estimates do reflect ex-ante market expectations (even if the estimates are biased).

The monthly distribution of the ICC estimates for equity is shown in Figure 1 and

[3] We give a detailed description of the estimation procedure for each measure in the appendix.

in Table 2. The mean cost of equity capital has been slightly decreasing over time starting at around 12% and ending at around 8% in 2016 which is natural considering the development in interest rates over the same period.

The ICC method for estimating the equity cost of capital deviates from prior studies on the cost of capital for banks. King (2009), Miles, Yang, and Marcheggiano (2013), Baker and Wurgler (2015), and Cline (2015) all use the CAPM as the starting point for estimating the expected return. We therefore benchmark our cost of capital estimates to similar estimates obtained from the CAPM. We look at both historical and forward looking realized betas (as in Baker and Wurgler (2015)) when estimating expected returns from the CAPM. Table 3 shows the performance of five different expected return proxies for equity, namely the ICC, the forward CAPM (F-CAPM), the historical CAPM (H-CAPM), forward beta ranking, and historical beta ranking.[4] Each month bank stocks are divided into quintiles based on the ranking according to the expected return estimate. This results in five portfolios and the table lists the yearly average expected return for each portfolio versus the realized one-year holding portfolio return. From the table we see that the relationship between expected returns and realized returns are most pronounced for the ICC and the forward CAPM as both of these proxies show a positive relationship between expected returns and realized returns. Except for the two lowest quintiles of the forward CAPM both of these proxies are monotonically increasing in realized returns. The returns from the beta ranking portfolios shows that our bank data also displays a low-risk anomaly as found in Baker and Wurgler (2015). Sorting on historical betas has very little correlation with realized returns whereas sorting on forward looking betas gives too low returns

[4]We explain in an appendix how these proxies are computed.

for the portfolio with the highest beta stocks. However, these anomalies are not present when using the ICC measure as the cost of capital estimate. One way of understanding this result is that analysts do not make their predictions using the flat security market line from Black, Jensen, and Scholes (1972).

Table 3 also reports a measure of the tracking ability of the expected return. This measure is the measurement error variance of the expected return proxy where a negative number indicates a better performance (see Lee, So, and Wang (2015)). By construction, a naive model using a constant expected return as the forecast would give a measurement error variance of zero. Both the ICC and the forward CAPM outperform the naive model. The forward CAPM seems to be the best performing expected return proxy. However, this is not really surprising since the expected return is calculated using both a forward beta and a forward market risk premium, both computed from future realized returns. Hence, expected returns from this model should by construction track realized returns very well.[5]

In order to further compare our expected return estimates to the approach from Baker and Wurgler (2015), we form portfolios pre-ranked on either ICC, forward beta, or the tier 1 capital ratio. Each month, stocks are sorted into quintiles based on one of these measures. The stocks are then held in the portfolio for 12 months. Next month new portfolios are formed again, and these portfolios are held together with those formed in the previous months, so that each overall portfolio return is an equally-weighted average of 12 concurrent portfolios, formed over the course of the last 12 months. The portfolios are only calculated on those stocks where in a

[5]In the paper we use the ICC approach. However, repeating the main regressions with the estimates from the forward CAPM yields similar results and return predictions are very close to each other.

given month all three of ICC, forward beta, and tier 1 capital are available. This creates a delisting bias in the returns because of the forward looking beta but it is still helpful in understanding the relationship between the various expected return measures. Table 4 shows the average monthly returns of the five portfolios together with average characteristics at the time of the pre-ranking. Panel A of Table 4 shows that the five portfolios sorted on ICC exhibit a spread both on the ICC and the realized returns. The tier 1 ratio is decreasing in ICC consistent with a higher tier 1 ratio resulting in lower equity risk. Finally, there is a minor spread in the betas across the portfolio in the direction expected from standard CAPM theory. In Panel B of Table 4 the portfolios are pre-ranked on forward beta. The average monthly returns are consistent with the low-risk anomaly found in Baker and Wurgler (2015). Furthermore, the relationship between tier 1 capital ratios and forward beta is very flat in our sample as can also be seen in Panel C of Table 4. Assuming as in Baker and Wurgler (2015) that asset betas are the same across banks and that bank debt is risk free, this indicates that the low-risk anomaly is even more pronounced in our sample than in the sample used in Baker and Wurgler (2015); as the tier 1 capital ratio is increased, banks do not get lower beta risk as they should according to theory and even if they had received a lower beta this would not have translated into a lower expected return.[6] The relation between average returns and the tier 1 ratio is rather weak in our portfolio sorts. This indicates that banks with the same capital structure could have different levels of asset risk (see e.g. Merton (1974)) which is something

[6] If all banks have the same asset beta and bank debt is risk free then asset beta and equity beta are proportional in the inverse equity ratio, $\beta^E = 1/E \times \beta^A$. When plotting the forward equity beta against the inverse tier 1 ratio, Baker and Wurgler (2015) find a linear relationship with an approximate intercept of zero. They find that for larger banks this relationship is more flat and the intercept is above zero. For our sample this relationship is almost completely flat.

that the ICC measure should already take account for. In the later regression analysis, the low-risk anomaly disappears when we take account of the individual bank's asset risk, the riskiness of bank debt, and use the expected equity return as derived from analyst earnings forecasts.

2.3 Expected return on debt capital

Obtaining cost of debt estimates for banks is difficult since a large part of their debt obligations are not freely traded securities. Hence, relying on senior bond rates issued by the individual banks will only be representative for a small part of the costs since senior debt usually accounts for only a small fraction of total bank debt. This is also the case in our sample, as senior debt amounts to approximately 3-10% of banks' total debt obligations depending on the quarter. Instead, we rely on realized interest expenses as reported by the banks in their financial statements. That is, we compute the cost of debt as the total interest paid over the last four quarters divided by the average total debt obligations over the same period but lagged by one quarter. We lag the debt obligations by one quarter in order to capture that the interest payments have been generated by the debt in place at the beginning of the quarter. For any given fiscal quarter, the cost of debt derived in this fashion will be a historical or backward looking measure of the cost of debt since it is essentially using interest payments over the last four quarters as an estimate of the expected cost of debt. To circumvent this, we have also tested forward looking measures in our main analysis.[7] However, the results are very robust to this change. Formally, we compute the cost

[7] We have tried summing over the coming four quarters or multiplying the current quarterly payment by four.

of debt capital for bank i at time t as:

$$r_{i,t}^{d} = \frac{\sum_{k=0}^{3} \text{Interest}_{i,t-k}}{\frac{1}{4}\sum_{j=1}^{4} \text{Debt}_{i,t-j}} \tag{2}$$

where t denotes quarter and i denotes bank. $r_{i,t}^{d}$ is the cost of debt, $\text{Interest}_{i,t}$ is the interest expenses in quarter t and $\text{Debt}_{i,t}$ is the total debt obligations ultimo fiscal quarter t. Since most banks have a short average maturity on a large part of their debt obligations, using the interest payments over a 1-year horizon should be a close approximation to the true cost of debt. Moreover, even though most deposits have floating rates, they are not adjusted at the same frequency as traditional variable debt. This increases the transparency of future interest payments over the next year as well.

A typical bank's debt obligations consist of deposits, short term debt, and senior debt/long term debt. The total interest expenses $\text{Interest}_{i,t}$ will be equal to the total sum of interest payments on each of these individual liabilities. Variation in the cost of debt between banks at a given point in time will therefore be a function of the bank's credit risk and the composition of their liabilities.

Table 2 and Figure 2 show the monthly distribution of the cost of debt capital estimates. These estimates has an extremely high correlation with the general interest rate level. The high correlation reflects that much of the debt has floating rate interest payments. Figure 3a shows the ratio of deposits to assets over time. As can be seen in the graph deposits make up a very large part of the funding for the average bank. This deposit funding is one of the main contributing factors increasing the correlation between the general interest rate level and the cost of debt capital.

2.4 Expected total cost of capital

We define the total cost of capital as the weighted average return demanded by investors. The total cost is therefore the portfolio-weighted expected return on equity and debt:

$$r_{i,t}^{\text{total}} = r_{i,t}^{e} \times \frac{E_{i,t}}{E_{i,t} + D_{i,t}} + r_{i,t}^{d} \times \frac{D_{i,t}}{E_{i,t} + D_{it}} \tag{3}$$

where t denotes month and i denotes bank. $r_{i,t}^{e}$ is the expected return on equity capital, $r_{i,t}^{d}$ is the expected return on debt capital, $E_{i,t}$ is the market value of equity and $D_{i,t}$ is the market value of debt. We follow the standard convention in the literature (see e.g. Fama and French (1993)) and approximate the market value of debt with the book value of debt.

The total cost of capital in Equation (3) measures the overall firm risk. It is thus the expected return that when used to discount all of the firm's future cash flows (including the tax shield) returns total firm value. By decomposing r_{it}^{total} with respect to the individual risk characteristics of the bank, i.e. asset risk, we can express it as:

$$r_{i,t}^{\text{total}} = r_{i,t}^{u} \times \frac{V_{i,t}^{u}}{V_{i,t}^{l}} + r_{i,t}^{l} \times \frac{L_{i,t}}{V_{i,t}^{l}} \tag{4}$$

where t denotes month and i denotes bank. $r_{i,t}^{u}$ is the unlevered firm risk or asset risk, $\frac{V_{i,t}^{u}}{V_{i,t}^{l}}$ is the fraction of unlevered firm value to total firm value, $r_{i,t}^{l}$ is risk associated with leverage, and finally $\frac{L_{i,t}}{V_{i,t}^{l}}$ is the fraction of net benefits from leverage to firm value. From Equation (4) the total cost of capital computed using Equation (3) will thus include any net benefits of leverage for the individual banks, as these will be embedded in $r^e_{i,t}$ and $r^d_{i,t}$. Differences between banks in their total cost of capital can therefore stem from differences in unlevered asset risk as well differences in net benefits of leverage. This derivation highlights that it is important to control for both leverage and asset risk in the empirical analysis.

Figure 4 shows the mean of the total cost of capital as well as the 10^{th} and 90^{th} percentiles of the monthly distributions. The overall negative trend is primarily driven by the negative trend in the cost of debt and also the slight negative trend in the cost of equity as shown in Figure 1 and Figure 2.

3 Determinants of the cost of capital for banks

In this section we run a set of regressions exploring the determinants of the cost of capital for banks. The main interest is in empirically identifying the relationship between tier 1 capital ratios and banks' funding costs. Theoretically, we would expect to see that the cost of equity capital and debt capital decreases when the bank uses more equity funding, i.e., more loss absorbing capital. However, it is unclear if the total cost of capital would be affected or not. For each cost of capital type we estimate the following main regression:

$$
\begin{aligned}
\text{Cost of capital}_{i,t} = {} & \beta_1 \times \text{Tier 1 ratio}_{i,t} + \beta_2 \times \text{Tier 2 ratio}_{i,t} \\
& + \beta_3 \times \text{Deposit ratio}_{i,t} + \beta_4 \times \text{Government support}_{i,t} \\
& + \text{Bank fixed effects}_i + \text{Time fixed effects}_t + \epsilon_{i,t}
\end{aligned}
$$

where t denotes month and i denotes bank. Cost of capital can then either be for equity, debt, or the total cost of capital. The bank fixed effects capture that two banks can have the same capital structure yet have different levels of asset risk as also shown in Equation (4). Time fixed effects capture any general market effect present in the given month which is primarily, but not entirely, the overall interest rate level. All regressions are estimated with cluster robust standard errors, clustered by bank and month (see e.g. Petersen (2009)). We discuss possible versions of the government support control variable in the next section.

3.1 Cost of equity capital

We use the ICC estimates from Section 2.2 as the measure of each bank's cost of equity capital. Table 5 shows the estimated regression coefficients for a range of specifications.

We find a significant negative relationship between the expected return and the tier 1 capital to risk-weighted assets ratio. This is consistent with banks having less risky equity when they decrease their leverage. The effect for tier 1 capital is larger, and generally more significant, than that found for tier 2 capital. This is likely due to the hybrid nature of tier 2 capital making it a semi-debt instrument. Including the deposit ratio into the regression does not change the estimated coefficient for the tier 1 ratio. The deposit ratio has a significantly negative estimate. This indicates that decreasing the amount of deposit funding will increase the cost of equity capital. This is consistent with a situation where deposits can be seen as cheap funding because it is insured by the FDIC or because depositors are willing to accept low depositor rates. Replacing deposits with equity in the capital structure is thus more expensive than replacing ordinary debt (which is likely fairly priced) for equity. Nevertheless, the total effect of substituting debt for equity still results in a lower cost of equity capital (we calculate the combined effect of various changes in the capital structure in Section 5).

During the 2008 financial crisis, many banks received government support. We include three different variables in order to capture the potential effect of the government support. The government purchased preferred shares in several banks under the Capital Purchase Program (CPP) and the Targeted Investment Programme (TIP). In regression specification 3, we include the fraction of total equity owned by the government. In specification 4, we include an indicator dummy which is 1 in the months where the government had an equity stake and 0 otherwise. Finally, in the last specification we include an indicator dummy which is 1 once the bank receives support and 0 before or if the bank never receives support. Hence, it measures a potential lasting effect which could come from a perception that the bank has now been deemed too-big-to-fail. The government support variables are slightly significant for the equity fraction owned by the government. This indicates that a high level of government involvement did decrease the cost of equity capital for the bank but that the effect is not large. The effect of government support that we test is over and above the direct effect from an increase in the tier 1 ratio due to the government supplying additional equity funding to the banks. On top of the bank specific effect there could also be an effect on the overall economy which is hidden in the time fixed effects.

3.2 Cost of debt capital

We use the expected return for the debt capital calculated in Section 2.3 as the cost of debt capital for the banks. Table 6 shows the estimated coefficients for various specifications of the regression.

As for the cost of equity capital, we see that increasing the tier 1 ratio decreases the cost of debt capital. When the level of debt funding becomes lower, the bank's credit risk decreases, all else equal, which should result in lower interest payments as seen in the regression. The effect of the tier 2 capital is positive but insignificant which could be an indication that having too much tier 2 capital is perceived negatively by market participants.

The deposit ratio is significant and negative, which indicates that deposits in general provide a cheaper source of funding than ordinary debt. Finally, receiving government support during the 2008 financial crisis did not do much to the interest payments over and above the direct effect from the increase in the tier 1 ratio. If anything, the effect points to higher costs of debt.

In the first four specifications, we use the largest possible sample for the years 1993-2016. Since the earnings forecasts are not needed for the calculation of the cost of debt capital, we can increase the sample to include also those banks without any earnings forecasts in IBES which is what we have done in these specifications. In the remaining specifications, the analyst earnings forecasts are the binding constraint and only banks with forecasts are included. Results are similar across the different samples.

3.3 Total cost of capital

Table 7 shows the estimated coefficients for various regressions with the total cost of capital as the dependent variable. Across all specifications, we find that the total cost of capital is independent of the tier 1 and tier 2 ratios. These findings are consistent with the principle of conservation of risk (Modigliani and Miller, 1958), namely that changing the capital structure does not change the overall riskiness of the firm but does impact the riskiness of debt and equity. We did see lower cost of equity and debt capital when the tier 1 capital increases but these effects balance out with the change in capital structure weights so that the combined portfolio is neutral. The capital structure irrelevance has to be modified in the following ways. First, we later consider the loss of tax shield which will immediately decrease the value of the bank or, alternatively, be offset by an increase in loan rates (Kashyap, Stein, and Hanson, 2010). However, as can be seen from Table 7, changing capital structure does not affect the total cost of capital. We thus split up the effect on funding rates (risk) and the effect on the value of the bank.[8] Second, looking at the estimated coefficient for the deposit ratio it is clear that deposits can be considered cheap funding. Substituting deposits for equity increases the total funding costs for the bank. The neutrality therefore only applies when equity is replacing ordinary debt.

There is also a minor effect of government support on the total cost of capital. Banks for which the government had an equity stake following the 2008 crisis in general receive a discount on their overall funding rate. However, the effect is

[8] The conventional WACC measure mixes up these two effects, but we choose to separate them for now. We return to the issue and reconsider the conventional WACC when we look at the tax shield loss explicitly.

economically small.

3.4 Bank size and time dependence

It is reasonable to believe that large banks and small banks exhibit different expected behaviour. Larger banks are typically active as players in repo and derivatives markets whereas smaller banks are not. This difference in activities and importance could maybe distort the relationship between the level of tier 1 capital and funding costs. Larger banks may also have a higher likelihood of being bailed out by the government (Gandhi and Lustig, 2015).

In Table 8 we look into the difference in the cost of capital for small versus the large banks. Each month we form the distribution of banks according to their asset size. In a given month, we then categorize a bank as small if it belongs in the bottom 20% of the asset size distribution and large if it belongs to the top 20% of the distribution. Looking at the cost of equity capital, the overall effect of increasing the tier 1 ratio is negative indicating that the cost of equity decreases with more equity funding as also found earlier. However, this effect is significantly smaller for large banks compared to other banks. The deposit ratio is not significant for the cost of equity capital, except for the large banks. This seems to indicate that deposits can be seen as cheap funding only for the larger banks but not for other banks, possibly because the associated capital requirements are (actuarially) fair for the small banks but may be too small for the larger banks.

For the cost of debt capital, we do not find significant differences between large and small banks. For the total cost of capital, the results are very similar to those found earlier. One thing to note is that the total cost of capital is slightly decreasing in the tier 1 ratio. Even though the interaction coefficient is insignificant for large banks, the sum of the overall effect and the large bank effect is very close to zero. Hence, the result from the equity cost of capital carries over to some extent to the total cost of capital. The smaller banks benefit from an increased tier 1 ratio, whereas larger banks have smaller benefits for the same increase. Our results can be compared to those of Gandhi and Lustig (2015) and Gandhi, Lustig, and Plazzi (2019) in that they also find that equity for large banks is a not an expensive funding source. However, we find the same for smaller banks and the effect that we find is not directly linked to government guarantees. Furthermore, according to our results equity is fairly priced whereas the other studies finds that equity can be considered cheap for larger banks.

In Table 9 the main regression has been interacted with time dummies. The 2008 dummy is 1 after 2008 and 0 before and the 2011 dummy is 1 after 2011 and 0 before that. The 2008 dummy should capture the potential effect of the crisis and the 2011 should capture the effect of the low interest rate environment. Looking at the cost of equity funding, tier 1 and tier 2 capital are more negative after the crisis indicating a larger effect of increasing the capital ratios. However, the effect on the cost of debt and the total cost of capital remains neutral, so that there continues to be a conservation of risk (Modigliani and Miller, 1958). With respect to the equity cost of capital, deposit funding is primarily cheap after the crisis but not before. The opposite is found for the total cost of capital, before the crisis more deposit funding decreases the total cost of capital, but gradually after 2008 and 2011 the effect becomes smaller. After 2011 during the low interest rate environment, having more deposit funding does not affect the total cost of capital.

3.5 Other capital ratios

Critics of the current focus on tier 1 capital to risk-weighted assets in the regulation, have pointed out that the tier 1 ratio might be easy to manipulate (see e.g. Admati and Hellwig (2013)). This might explain why larger banks had a smaller effect of increasing their tier 1 ratio compared to smaller banks as found in the former section. If larger banks have the ability to manipulate their tier 1 ratio they may not be considered less risky even when increasing their tier 1 ratio. As an alternative to the tier 1 ratio Admati and Hellwig (2013) suggest using the leverage ratio for capital requirements, i.e., the tier 1 capital to total assets. The Basel III regulation has also introduced other capital requirement ratios, e.g., a minimum ratio for the common equity tier 1 ratio (CET1). In the following regressions, we replace the tier 1 ratio for various other variations of bank leverage.

Most US banks have to fulfil a leverage requirement based on tier 1 capital to total assets. In Table 10 we look at this measure. Consistent with the earlier findings in this paper, we see that equity and debt costs are decreasing in this leverage measure, whereas total funding costs are unaffected. Hence, more loss absorbing capital decreases funding costs for debt and equity. But the total cost of capital remains neutral. This indicates that the market perception of tier 1 capital to RWA and tier 1 capital to total assets are very similar.

In Table 11 bank leverage is measured as common equity to risk-weighted assets (RWA) and in Table 12 bank leverage is common equity to total assets. Common equity is here defined using the accounting definition and not the regulatory tier 1 definition. Again, we see that increasing the level of equity funding decreases the cost of equity and debt capital. However, now there is a small positive effect on the total funding costs. Hence, increasing the amount of common equity to assets seems to also increase total funding costs. However, the results are economically small and are likely driven by the composition of common equity on the balance sheet. Common equity includes, e.g., goodwill and tax deferrals which are not directly related to funding. The ex-ante expected relationship between funding costs and common equity is thus not well determined. This is the main reason for using the tier 1 capital definition for regulatory purposes.

Finally, we also use the common equity tier 1 ratio (CET1) as a measure of bank leverage. In Table 13 we, again, get the same pattern that more equity funding decreases equity and debt funding costs but that the total funding costs remain neutral. Note that there is a smaller number of observations in this regression because banks do not report the CET1 ratio in their financial statements until around 2014. Leading up to the analysis in the next section, we also use the distance between the CET1 capital requirement for being considered well-capitalized for the individual bank and the level of the CET1 ratio for the bank as a regressor. This is a measure of the size of the buffer for the bank. In Table 13 it is clear that there is not much difference between using the buffer or using the capital ratio itself. There is very little cross sectional variation in the capital requirements across banks which is why there is little difference between using the actual ratio or the buffer when we also include a time fixed effect in the regression.

3.6 Capital buffer sizes

For each bank we hand-collect the bank's individual capital requirements as stated in their quarterly financial statements. The capital requirements are usually reported up to a year before they go into effect. Specifically, we collect the capital requirement and the requirement for being well-capitalized for each bank for the following requirements; tier 1 capital to risk-weighted assets, tier 1 capital to assets, total risk based capital (tier 1 plus tier 2 capital) to risk-weighted assets, and the CET1 ratio.

Table 15 shows the correlation between the distances to the various capital requirements, i.e, the bank buffers. The capital requirement and the requirement for being well-capitalized are nearly always set at a fixed distance, so that the measures are almost perfectly correlated. In general all the capital requirements are highly correlated, so that including more than one of them into a regression could create a problem with multicollinearity. In Table 16 we include both the CET1 ratio and the distance to the requirement for being well-capitalized based on the CET1 ratio (the CET1 buffer). As before we see that having more equity financing reduces the cost of equity and debt capital. It seems that having a positive buffer could be considered expensive but because of the high correlation between the CET1 ratio and the size of the buffer this interpretation is problematic. The combined effect of the two variables is still as found earlier. In Table 13 we did see that having only one of them in the regression gave the same results as in the main regressions. Table 16 also includes regressions with tier 1 ratio and the size of the buffer based on the tier 1 ratio. The main implications are as earlier.

3.7 Asset volatility

So far all the regressions have been with a bank fixed effect in order to capture differences between banks with regards to their asset risk. Banks may have the same capital structure but different levels of asset risk. As a robustness test, we exclude the bank fixed effects and instead introduce an asset volatility measure into the regression.

We measure asset volatility as the ratio of assets to risk-weighted assets. If the bank asset portfolio is risky, we would expect this measure to be low (close to 1) and if the bank has safe assets it should be high. In Table 14 we have included the asset risk measure. Consistent with theory, we see that higher asset risk also implies higher total cost of capital. Also consistent with the earlier regressions, we see that the cost of equity capital is decreasing in the tier 1 ratio. However, the relationship between the cost of debt capital and the tier 1 ratio is now insignificant, although with the same sign as earlier. We would also have expected asset risk to have had an impact on the cost of debt and equity capital. While the sign of asset risk is as expected, the coefficients are not significant. Hence, asset risk is important for the total cost of capital as expected and, furthermore, the bank fixed effects do capture some important idiosyncratic bank characteristic.

4 Tax shield loss

The cost of capital results in the earlier regressions have been from the perspective of the investor or the holders of (all) the equity and debt. The analysis thus ignored the loss of tax shield and other potential externalities which might change when the capital structure changes. We can think about the capital structure of the bank in the following way resembling trade-off theories of capital structure:

$$
\begin{aligned}
V &= E + D \\
&= PV(\text{Assets}) + PV(\text{Externalities}) \\
&= PV(\text{Assets}) + PV(\text{Tax shield}) - PV(\text{Bankruptcy costs})
\end{aligned}
$$

where Externalities could be many different things but which in the simplest version of the trade-off theory is the tax shield and the bankruptcy costs. Stating the same relationship in expected returns gives the following portfolio return relationship:

$$
\begin{aligned}
r^{\text{total}} &= r^e \times \frac{E}{E+D} + r^d \times \frac{D}{E+D} \\
&= r^{\text{Assets}} \times \frac{PV(\text{Assets})}{E+D} + r^{\text{ex}} \times \frac{PV(\text{Externalities})}{E+D} \\
&= r^{\text{Assets}} \times \frac{PV(\text{Assets})}{E+D} + r^{\text{tax}} \times \frac{PV(\text{Tax shield})}{E+D} - r^{\text{bc}} \times \frac{PV(\text{Bankruptcy costs})}{E+D}
\end{aligned}
$$

The results from Section 7 indicates that the total cost of capital r^{total} is independent of the capital structure. Increasing the equity ratio reduces the present value of the tax shield shifting the balance of the terms in the last equation. Since the total cost of capital is unchanged, this could indicate that the tax shield return r^{tax} is equal to the asset return r^{Assets} and possibly the bankruptcy cost return r^{bc} and that they are all equal to the total cost of capital. This is similar to the argument in Miles and Ezzell (1980) that tax shield and assets have the same level of risk and therefore expected return. In Miles and Ezzell (1980) this is because the firm rebalances to a target capital structure. In Miller (1977) the tax shield is assumed to have an expected return equal to the cost of debt capital, i.e., a lower return than the total cost of capital. However, if this were the case for our data sample then we would expect the total cost of capital r^{total} to increase when less of the overall firm value comes from the tax shield.

For a rough approximation of the tax shield, we will therefore assume that the future tax savings can be discounted by the total cost of capital. Furthermore, we assume that the current level for the cost of debt capital and the face value of debt remains constant so that we can calculate the present value of the tax shield as:

$$PV(\text{Tax shield})_{i,t} = \frac{r^d_{i,t} \times D_{i,t} \times tax}{r^{\text{total}}_{i,t}}$$

where i denotes bank and t denotes month. $D_{i,t}$ is the market value of debt, which we approximate with the face value of debt. The cost of debt capital is $r^d_{i,t}$ and tax is the tax rate. Once we have estimated the present value of the tax shield, we form the tax shield ratio by dividing with the market values of equity plus debt. Figure 5 shows the time series distribution of the tax shield ratio. The average lies around 30% indicating that the tax shield comprises 30% of the total bank firm value. However, the tax shield value is highly correlated with the general interest rate level which means that the tax shield is much lower in the later sample period. It is down to an average of 7% in 2016.

Table 17 shows the main regression specification with the tax shield ratio as the dependent variable. We use two different assumptions about the tax rate. First, we assume that the banks can save the federal tax rate, and, second, we calculate a bank specific tax rate derived from the implicit tax rate paid by the individual bank in the given year. Both tax rate assumptions give similar results; when the tier 1 capital ratio increases, the tax shield ratio decreases. The coefficients indicate that an increase in the tier 1 ratio from 0 to 100% decrease the firm value by 19.24% (with the federal tax rate assumption and before the 2008 crisis). This effect is larger during other time periods and with the firm tax assumption making the 19.24% a kind of lower bound. This indicates that the present value of the tax shield decreases significantly when the amount of interest earning debt is reduced. It is also apparent with the federal tax rate that increasing the amount of deposits lowers the tax shield value. This is likely because deposits then substitute for ordinary debt with a higher interest payment.

The regressions also include interacted time dummies capturing before and after the 2008 crisis, and before and after the low interest rate environment starting in 2011. Looking at the interaction effects with tier 1 capital ratios, increasing the tier 1 ratio after 2008 or 2011 has a more negative effect than before the crisis. The same is the case for the deposit to asset ratio; increasing the deposit to asset ratio after 2011, in the low interest rate environment, significantly reduces the value of the tax shield. This can seem counter-intuitive since the effect of deposits on funding rates becomes weaker after 2011. However, when deposits substitute for other debt with higher interest payments, the present value of the foregone interest payments is higher when the discount rate of the tax shield asset is also low. The low discount rate for the tax shield asset is thus driving the result.

Finally, we note that the tax shield loss we calculate is an upper limit on the total loss in bank firm value. Increasing the equity ratio lowers the tax shield but at the same time decreases the expected bankruptcy costs. We ignore the latter effect in the following assessment on the impact of changing the capital structure.

5 The effect on capital costs from changing capital structure

In this section we investigate the impact of changing the capital structure as suggested by the former empirical results. In our setting changing the capital structure will have two effects. First, it will impact the funding rates, i.e., the cost of capital. Second, it will have an immediate effect on the bank firm value which could be translated into an equivalent increase in loan rates.

In Table 18, we have collected the implied effect of changing the tier 1 ratio by 2.5 percentage points. Extrapolating from the regressions implies that the cost of equity capital should decrease by 20 bps, the cost of debt capital should decrease by 5 bps, and the total cost of capital should decrease by 2 bps. At the same time the firm value should decrease by up to 57 bps from the loss of tax shield. Hence, while the cost of capital did not change there will be an immediate loss of firm value for the banks, so that there is a trade-off between higher capital ratios and bank firm values. Looking at an even larger change in the tier 1 capital ratio by 10 percentage points which is more in line with that suggested in Admati and Hellwig (2013), we see that the tax shield loss is up to 2.27% of total firm value. Looking only at the more recent sample period this number would be around 3.09%.

The former calculations implicitly assume that equity is substituted for ordinary debt. However, it may be worth looking at the impact of substituting deposits for equity. Looking at the large change in tier 1 ratio, we see that the total funding cost will not change, and that the tax shield loss will be 1.85% of bank firm value. This number is slightly lower if we only use estimates from the most recent period.

Kashyap, Stein, and Hanson (2010) argue that the conventional after-tax WACC can be said to resemble the average customer borrowing costs. Hence, the increase in WACC from the loss of firm value would likely be transferred to customers in the form of higher loan rates. We can use the implied changes in the tax shield value to infer the equivalent increase in WACC and therefore loan rates[9] (ignoring the change in expected bankruptcy costs). Table 18 shows that the increase in loan rates for a 10 percentage point increase in the tier 1 ratio would be around 8.5 bps. However, if equity substitutes for deposits and we use the estimates for the most recent time period the increase in loan rates would only be 2.3 bps. These estimates are far smaller than the 25 basis point estimate from Kashyap, Stein, and Hanson (2010) and the 60 to 90 basis point estimate from Baker and Wurgler (2015).

6 Conclusion

We quantify to what extent equity funding can be considered expensive for banks. Empirically, we find evidence supporting the conservation of risk principle (Modigliani and Miller, 1958). When the tier 1 capital ratio is increased, the cost of equity and debt capital decreases but the total cost of capital is unchanged. This indicates that investors do not change their required rate of returns on the total portfolio of bank securities when the bank changes its capital structure.

The primary negative effect of increasing the tier 1 ratio is a loss of tax shield. If equity replaces deposits in the capital structure and the tier 1 ratio is increased by 10 percentage points, the estimated firm value loss is 1.55% after 2011. This firm value

[9] The relationship between WACC and the tax shield loss regression is derived in Section A2 of the appendix.

loss could be offset by an increase in customer loan rates of around 2 bps. The 2 bps is far smaller than that found in earlier studies (see Kashyap, Stein, and Hanson (2010) and Baker and Wurgler (2015)). From a social planner perspective it is not clear that the loss of tax shield would also be a welfare loss if loan rates are not increased (Admati and Hellwig, 2013). The firm value loss due to lower tax shield would be a redistribution of taxation income for the government.

A1 Appendix: The implied cost of capital (ICC)

The ICC used in this paper is computed as the average of four commonly used ICC metrics, ICC^{OJ}, ICC^{PEG}, ICC^{GLS} and ICC^{CT}. To use an equal-weighted average of several individual ICC measures has been a successful way of reducing noise in the final ICC estimate, see for instance Mohanram and Gode (2013). In this appendix we describe how each of the four metrics are computed. The four different ICC measures can be split into two groups - those that use the model of Ohlson and Juettner-Nauroth (2005) (OJ) and those that use the residual-income model (RI).

A1.1 ICC based on the OJ model

Ohlson and Juettner-Nauroth (2005) suggest using following model to calculate the implied cost of capital:

$$ICC^{OJ} = A + \sqrt{A^2 + \frac{EPS_1}{P_0} \times (STG - (\gamma - 1))}, \tag{5}$$

where

$$A = \frac{1}{2}\left((\gamma - 1) + \frac{DPS_1}{P_0}\right)$$

and

$$STG = (\frac{EPS_2 - EPS_1}{EPS_1} \times LTG)^{\frac{1}{2}}$$

and where EPS_1 and EPS_2 are forecasts of one- and two-year-ahead earnings per share. LTG is the forecasted long term growth rate as given by analysts. We get the forecasts from IBES and we conduct our analysis using both the mean and median of the forecasts. Our results are robust to this choice. P_0 is the price at the time when the forecasts are made, DPS_1 is the forecast of one-year-ahead dividend per share. Actual forecasts of DPS_1 are very few so instead we define it as the most recent payout ratio, where the payout ratio is estimated as the most recent dividend to net earnings as taken from Compustat. For banks with negative earnings we set the estimate of the payout ratio as the most recent dividend divided by 6% of assets as done in Mohanram and Gode (2013).[10] STG is the growth in short term earnings which we define similar to Mohanram and Gode (2013). Finally, $(\gamma - 1)$ is the expected long term growth rate. Similar to both Mohanram and Gode (2013), Gode and Mohanram (2003) and Claus and Thomas (2001) we set this equal to the yield on 10 year treasury minus 3%.

We compute a simplified version of ICC^{OJ} similarly to Easton (2004) and Mohanram and Gode (2013) by ignoring dividends and setting γ equal to 1. Doing so yields:

$$ICC^{PEG} = \sqrt{\frac{EPS_1}{P_0} \times STG} \tag{6}$$

where STG is defined similarly as for the ICC^{OJ} model.[11]

[10] 6 % of assets might sound high for a bank, as banks usually do earn a return on assets of this magnitude. For this reason, we also try to set it equal to 1 % which is the average ratio occurring in our sample. Our results are robust to this choice.

[11] We also compute the the modified PEG measure, ICC^{MPEG}, see for instance Easton (2004). Substituting ICC^{MPEG} for ICC^{PEG} when computing the average ICC have no real impact on our results.

A1.2 ICC based on the residual income model

The two most commonly used approaches based on the residual income model are those of Gebhardt, Lee, and Swaminathan (2001) and Claus and Thomas (2001). The residual income model is given as:

$$P_0 = B_0 + \sum_{t=1}^{\infty}(1+r^e)^{-t} \times EPS_{t+1} - r^e \times B_t$$

which is directly derived from a traditional dividend discount model.

We estimate ICC^{GLS} from Gebhardt, Lee, and Swaminathan (2001) as:

$$P_0 = B_0 + \sum_{t=1}^{12} \frac{((ROE_t - ICC^{GLS}) \times B_{t-1})}{(1+ICC^{GLS})^t} + \frac{(ROE_{12} - ICC^{GLS}) \times B_{11})}{ICC^{GLS} \times (1+ICC^{GLS})^{11}} \qquad (7)$$

where P_0 and B_0 is the price per share and book value of equity per share at the time of the estimation. ROE_t is the return on equity at time t defined as:

$$ROE_t = \frac{EPS_t}{B_{t-1}}$$

where EPS_t is the earnings per share at time t and B_{t-1} is the book value of equity at time $t-1$. We construct forward book values using clean surplus accounting as:

$$B_t = B_{t-1} + EPS_t - DPS_t$$

where B_{t-1} is the book value of equity at time $t-1$, EPS_t is earnings per share at time t and DPS_t is the dividends per share at time t. For each point in time we estimate ROE_1 and ROE_2 using the earnings forecasts from IBES. Beyond the forecast horizon, we assume that the ROE fades linearly to the industry median by year 12. We estimate the median ROE using 10 years of historical data. Finally, we numerically solve for ICC^{GLS} in equation (7).

Very similarly to ICC^{GLS} the ICC^{CT} is given as:

$$P_0 = B_0 + \sum_{t=1}^{5} \frac{(ROE_t - ICC^{CT}) \times B_{t-1}}{(1 + ICC^{CT})^t} + \frac{(ROE_5 - ICC^{CT}) \times B_4 \times (1+g)}{(ICC^{CT} - g) \times (1 + ICC^{CT})^5} \quad (8)$$

where ROE_t is the return on equity for time t, B_{t-1} is the book value of equity at time $t-1$ and g is the long term growth rate. For each point in time we estimate ROE_1 and ROE_2 using the earnings forecasts from IBES. Beyond the forecast horizon we use analyst long-term growth estimates to compute ROE_t. We calculate future book values similarly to how we do it for the GLS model. Similar to both Mohanram and Gode (2013), Gode and Mohanram (2003) and Claus and Thomas (2001) we set g equal to the yield on 10 year treasury minus 3%. Finally, we numerically solve for ICC^{CT} in equation (8).

After having obtained the different ICC measures we take a simple equal-weighted average to obtain the ICC^{AVG} we use in our analyses. That is,

$$ICC^{AVG} = \frac{ICC^{CT} + ICC^{GLS} + ICC^{OJ} + ICC^{PEG}}{4} \quad (9)$$

A1.3 Expected return using CAPM

The traditional Sharpe-Lintner Capital Asset Pricing Model states that the expected return of a stock is equal to:

$$\mathbb{E}[r_{t+1}] = r^f + \beta_t * RP_t \tag{10}$$

Where $\mathbb{E}[r_{t+1}]$ is the expected return, r^f is the risk-free rate, β_t is the systematic risk factor, and RP_t is the market risk premium. To obtain estimates of β_t we run the following regression:

$$er_{i,\tau} = \alpha_{i,t} + \beta_{i,t} * RP_\tau + \epsilon_{i,t} \tag{11}$$

where $er_{i,\tau}$ is equal to the excess return of the bank i, $\alpha_{i,t}$ is a constant , $\beta_{i,t}$ is the systematic risk factor, RP_τ is the excess return on the market portfolio, and finally $\epsilon_{i,t}$ is an error term of the model. Note that τ is given as $t+/-$ 23 to 59 such that we compute both a historical- and forward beta for every time t. In other words, beta is computed using a minimum of 24 and a maximum of 60 months of historical or forward holding period returns. Using this methodology we obtain a historical beta, $\beta_{i,t}^{hist}$, estimated on historical return data and a forward beta, $\beta_{i,t}^{for}$, estimated using future return data. The way we compute forward beta is identical to the one in Baker and Wurgler (2015).

We use equation (10) to estimate two pairs of expected returns for each bank. For both of them we use the yield on a 1-year treasury bond as a proxy for the risk free rate. For the historically computed beta, $\beta_{i,t}^{hist}$, we use a market risk premium computed on the last 12 months of historical returns. For the forward beta, $\beta_{i,t}^{for}$, we use a market risk premium computed on 12 months of forward returns - that is, the market risk premium is the actual market risk premium over the following 12 months. Note that this approach deviates from the standard approach of using a constant risk premium. The constant risk premium approach would be equivalent to the beta raking approach used in the paper. Our choice of a 1-year risk free rate and market risk premium is in line with Lee, So, and Wang (2015). Following this methodology we obtain expected returns denoted by $\text{CAPM}_{i,t}^{for}$ for the forward CAPM and $\text{CAPM}_{i,t}^{hist}$ for the historical CAPM.

A2 From tax shield loss to loan rate increase

In order to illustrate how we get from the tax shield loss to an increase in loan rates, consider a project financed by equity E_t and debt D_t. The project yields a free cash flow FCF_{t+1} next year (which could be extended with a continuation value). The expected value of the investment should be equal to the expected cash flow from the project:

$$\begin{aligned} E_t \times (1 + r^E) + D_t \times (1 + r^D) &= FCF_{t+1} + PV_t(\text{Tax shield}) - PV_t(\text{Bankruptcy costs}) \\ &= FCF_{t+1} + D_t \times r^D \times \tau - PV_t(\text{Bankruptcy costs}) \end{aligned}$$

where t is the time, τ is the tax rate, r^E is the expected equity return, and r^D is the expected debt return. Rearranging the terms and multiplying and dividing by

$E_t + D_t$ give:

$$(E_t + D_t)\left(1 + \frac{E_t}{E_t + D_t} \times r^E + \frac{D_t}{E_t + D_t} \times r^D - \frac{D_t}{E_t + D_t} \times r^D \times \tau + \frac{PV_t(BC)}{E_t + D_t}\right) = FCF_{t+1}$$
$$(E_t + D_t)(1 + WACC_t) = FCF_{t+1}$$

where we have extended the classic weighted average cost of capital (WACC) with the expected bankruptcy costs. The conservation of risk principle and our empirical analysis suggest that the sum of the first two terms of the WACC is unchanged when changing the capital structure. WACC will thus change because of a change in the last two terms when the capital structure changes. In the tax shield analysis, we look at changes in the third term of the WACC divided by the total cost of capital r^{Total} which gives $(D_t/(E_t + D_t) \times r^D \times \tau)/r^{\text{Total}}$. In order to get the third term of the WACC, we therefore need to multiply the change in tax shield value by the total cost of capital (which is not affected by the change in capital structure). The change in WACC coming from the loss of tax shield can thus be calculated as:

$$\Delta WACC = r^{\text{Total}} \times \Delta \frac{PV(tax)}{E + D}$$

In doing this, we ignore the change in the expected bankruptcy costs. Note that the WACC assumes that ratios are calculated using market values. Our main measure of leverage is the tier 1 capital to risk-weighted assets which is a scaled book value measure. The relationship between an increase in the tier 1 ratio and the corresponding change in tax shield and therefore WACC is not obvious. This is the reason why we estimate empirically how the tax shield is related to the tier 1 ratio in Table 17.

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Table 1: Data Sources

This table lists the data used to conduct the analysis. Some of the variables of the Compustat Bank database are not available in the original Compustat database. The Tickers are unique identifiers for the given variable of interest.

Data Description	Datasource	Ticker
Total Interest Expenses	Compustat Bank	XINT
Common Equity	Compustat Bank	CEQ
Total Liabilities	Compustat Bank	LT
Income Before Extraordinary Items	Compustat Bank	IB
Income Tax Applicable to Current Operating Earnings	Compustat Bank	ITACOE
Dividends Paid to Common Equity	Compustat Bank	DVC
Total Deposits	Compustat Bank	DPTC
Total Long Term Debt	Compustat Bank	DLTT
Total Assets	Compustat Bank	AT
Tier 1 Capital to Risk-Weighted-Assets	Compustat Bank	CAPR1
Tier 2 Capital to Risk-Weighted-Assets	Compustat Bank	CAPR2
Risk-Weighted Assets	Bank Regulatory and Hand-collected	RCFDA223
Average total assets	Bank Regulatory and Hand-collected	RCFDA224
Tier 1 Capital	Bank Regulatory and Hand-collected	RCFD8274
Tier 2 Capital	Bank Regulatory and Hand-collected	RCFD8275
Equity Capital	Bank Regulatory and Hand-collected	RCFD3210
CET1 capital	Hand-collected	NA
CET1 requirement	Hand-collected	NA
Basic leverage ratio requirement	Hand-collected	NA
Well-capitalized leverage ratio requirement	Hand-collected	NA
Basic total risk based capital requirement	Hand-collected	NA
Well-capitalized total risk based capital requirement	Hand-collected	NA
Basic Tier 1 to RWA requirement	Hand-collected	NA
Well-capitalized Tier 1 to RWA requirement	Hand-collected	NA
Price Per Share	IBES	IBP
Outstanding Shares	IBES	IBNOSH
Median Earnings Per Share Forecast Fiscal Year-1	IBES	EPS1MD
Median Earnings Per Share Forecast Fiscal Year-2	IBES	EPS2MD
Median Long Term Growth Forecast	IBES	LTMD
Monthly Stock Returns	CRSP	RET
Monthly Value-Weighted Market Return	CRSP	VWRET
30-day T-bill (Monthly Risk-Free Rate)	CRSP	NOT INFORMED

Table 2: Summary statistics

This table presents monthly summary statistics for banks. The cost of equity r^e, the cost of debt r^d, and the total cost of capital r^a has been defined in Section 2. These variables are measured in percentage points. All variables are based on data compustat except where Bank Regulatory is mentioned in the table. The Government support variable is the fraction of the equity owned by the government as part of the crisis support packages. The tax shield ratio is defined in Section 4.

	Mean	S.D.	Q1	Median	Q3	Obs.
r^e	9.265	1.899	8.024	8.995	10.296	51479
r^d	2.814	1.554	1.604	2.863	3.952	49052
r^{total}	3.733	1.420	2.742	3.797	4.785	49052
Tier1 ratio	0.116	0.041	0.091	0.111	0.134	135522
Tier1 ratio (Bank Regulatory)	0.128	0.043	0.103	0.120	0.142	100073
Tier1 to assets ratio	0.092	0.024	0.078	0.089	0.102	99850
Tier2 ratio	0.037	0.045	0.012	0.015	0.046	134608
Tier2 ratio (Bank Regulatory)	0.016	0.010	0.011	0.013	0.015	100004
Tier2 to assets	0.012	0.008	0.008	0.009	0.012	99582
Deposit to assets	0.751	0.109	0.691	0.771	0.829	158925
Equity to assets	0.097	0.041	0.075	0.090	0.110	158908
Equity to RWA	0.128	0.049	0.099	0.120	0.145	99417
CET1 ratio	0.131	0.048	0.104	0.120	0.142	7532
Gov. Support	0.015	0.469	0.000	0.000	0.000	158912
Assets to RWA	1.390	0.291	1.214	1.341	1.502	95861
Tax shield to firm value	0.208	0.065	0.170	0.223	0.255	50880

Table 3: Performance of expected return proxies

This table shows the performance of various expected return proxies. For each expected return proxy, we sort stocks from highest return to lowest expected return on a monthly basis. The average yearly expected return over time is then compared to the realized return for each sort. ICC is the implicit cost of capital proxy. F-CAPM is for expected returns calculated using forward betas and a forward risk premium, i.e, beta is calculated using 24-60 months and the market risk premium is calculated using the following year's realized returns. H-CAPM is for expected returns using a historical beta and risk premium calculated over the last year. F-beta and H-beta are defined in a similar way, but the sorts are formed just using the beta. Tracking error ability is the test from Lee, So, and Wang (2015) evaluating the return predictability. A lower number indicates a better predictor.

Expected return proxy	ICC		F-CAPM		H-CAPM		F-Beta		H-Beta	
Quantile	$\mathbb{E}[r_{t+1}]$	r_{t+1}	$\mathbb{E}[r_{t+1}]$	r_{t+1}	$\mathbb{E}[r_{t+1}]$	r_{t+1}	β_t	r_{t+1}	β_t	r_{t+1}
1	7.4	7.1	4.9	7.0	5.3	8.3	0.3	10.4	0.2	9.9
2	8.4	9.8	8.2	9.1	7.9	10.2	0.5	10.4	0.5	11.0
3	8.9	11.4	10.1	10.0	9.7	10.3	0.7	10.0	0.7	10.3
4	9.6	12.5	12.0	11.0	11.3	11.8	1.0	9.6	0.8	11.1
5	11.1	13.6	16.5	13.6	15.5	12.6	1.4	9.7	1.2	11.2
Observations per quantile	9400		8601		8472		8601		8472	
Tracking ability of returns	-0.15		-0.96		1.45		9.13		7.92	

Table 4: Portfolio Sorting

This table shows the performance of portfolios sorted on either ICC, forward beta (F-beta), or Tier 1 ratio. Each month stocks are sorted into five portfolios. Each portfolio is held for 12 month. The portfolio return is the equally-weighted average over the constituents. The overall portfolio strategy return is the average return of the portfolios formed up to 12 month earlier. Stocks are only included into this analysis if observations of ICC, forward beta, and Tier 1 ratio are all present for a given month. For each portfolio, the average of the other measures are also calculated at the time of the return. H-beta is the historical beta calculated with monthly data with 24 to 60 month of data.

Panel A: Sorted on ICC

Portfolio	Monthly Return	ICC	Tier 1 to RWA	F-Beta	H-Beta
1	0.77	7.6	0.122	0.76	0.64
2	0.89	8.5	0.115	0.78	0.64
3	1.01	9.0	0.111	0.79	0.67
4	1.14	9.5	0.108	0.82	0.70
5	1.28	10.5	0.107	0.88	0.79

Panel B: Sorted on F-Beta

Portfolio	Monthly Return	ICC	Tier 1 to RWA	F-Beta	H-Beta
1	1.03	8.8	0.116	0.37	0.50
2	1.02	8.8	0.114	0.61	0.59
3	1.04	9.0	0.110	0.76	0.68
4	0.96	9.2	0.109	0.93	0.76
5	1.00	9.3	0.113	1.35	0.90

Panel C: Sorted on Tier 1 to RWA

Portfolio	Monthly Return	ICC	Tier 1 to RWA	F-Beta	H-Beta
1	1.02	9.4	0.082	0.83	0.75
2	0.96	9.2	0.098	0.85	0.72
3	0.99	9.0	0.109	0.81	0.67
4	1.08	8.8	0.122	0.78	0.64
5	1.04	8.6	0.150	0.77	0.65

Table 5: Cost of Equity Capital

This table presents estimated coefficients for various regressions with the cost of equity capital (in percentage points) as the dependent variable (defined in Section 3.1). Deposits to assets is the book value of deposits to book value of asset. Government support measures the government's equity stake as a fraction of the total bank equity. Government support dummy1 is equal to 1 in the years where the government had an equity stake in the bank and 0 otherwise. Government support dummy2 is equal to 1 after a bank received government support and 0 before. The regressions are calculated with cluster robust standard errors over bank and month. The regressions are with bank and month fixed effects.

VARIABLES	(1) r^e	(2) r^e	(3) r^e	(4) r^e	(5) r^e
Tier1 ratio	-7.619***	-7.863***	-7.940***	-7.893***	-8.171***
	(1.354)	(1.371)	(1.377)	(1.372)	(1.329)
Tier2 ratio		-3.451*	-3.768**	-3.722*	-3.880**
		(1.916)	(1.907)	(1.918)	(1.899)
Deposit to assets			-1.144*	-1.140*	-1.167*
			(0.609)	(0.608)	(0.606)
Gov. Support			-0.472*		
			(0.267)		
Gov. Sup. Dummy1				-0.146	
				(0.180)	
Gov. Sup. Dummy2					0.151
					(0.168)
Observations	46,511	46,349	46,349	46,349	46,349
R-squared	0.677	0.678	0.678	0.678	0.678
Bank FE	YES	YES	YES	YES	YES
Month FE	YES	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6: Cost of Debt Capital

This table presents estimated coefficients for various regressions with the cost of debt capital (in percentage points) as the dependent variable (defined in Section 3.2). Specification (1) to (4) use all available banks whereas (5) to (8) is restricted to the banks covered by analyst forecasts. Deposits to assets are the book value of deposits to book value of asset. Deposits to assets is the book value of deposits to book value of asset. Government support measures the government's equity stake as a fraction of the total bank equity. Government support dummy1 is equal to 1 in the years where the government had an equity stake in the bank and 0 otherwise. Government support dummy2 is equal to 1 after a bank received government support and 0 before. The regressions are calculated with cluster robust standard errors over bank and month. The regressions are with bank and month fixed effects.

VARIABLES	(1) r^d	(2) r^d	(3) r^d	(4) r^d	(5) r^d	(6) r^d	(7) r^d	(8) r^d
Tier1 ratio	-2.323***	-2.334***	-2.313***	-2.378***	-1.781***	-1.817***	-1.778***	-1.816***
	(0.296)	(0.298)	(0.297)	(0.299)	(0.632)	(0.632)	(0.628)	(0.645)
Tier2 ratio	0.382	0.381	0.396	0.363	1.134	1.121	1.136	1.114
	(0.405)	(0.405)	(0.405)	(0.404)	(0.922)	(0.922)	(0.924)	(0.929)
Deposit to assets	-1.243***	-1.250***	-1.248***	-1.248***	-0.604**	-0.605**	-0.604**	-0.608**
	(0.186)	(0.187)	(0.187)	(0.185)	(0.304)	(0.304)	(0.304)	(0.303)
Gov. Support		0.002				0.322***		
		(0.003)				(0.059)		
Gov. Sup. Dummy1			-0.031				-0.003	
			(0.040)				(0.064)	
Gov. Sup. Dummy2				0.053				0.028
				(0.043)				(0.074)
Observations	112,022	111,847	111,847	112,022	44,198	44,198	44,198	44,198
R-squared	0.926	0.926	0.926	0.926	0.910	0.910	0.910	0.910
Bank FE	YES	YES	YES	YES	YES	YES	YES	YES
Month FE	YES	YES	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7: Total Cost of Capital

This table presents estimated coefficients for various regressions with the total cost of capital capital (in percentage points) as the dependent variable (defined in Section 3.3). Deposits to assets is the book value of deposits to book value of asset. Government support measures the government's equity stake as a fraction of the total bank equity. Government support dummy1 is equal to 1 in the years where the government had an equity stake in the bank and 0 otherwise. Government support dummy2 is equal to 1 after a bank received government support and 0 before. The regressions are calculated with cluster robust standard errors over bank and month. The regressions are with bank and month fixed effects.

VARIABLES	(1) r^{total}	(2) r^{total}	(3) r^{total}	(4) r^{total}	(5) r^{total}
Tier1 ratio	-0.007	-0.565	-0.647	-0.555	-0.535
	(0.005)	(0.547)	(0.540)	(0.534)	(0.540)
Tier2 ratio		1.200	0.999	1.058	1.059
		(0.827)	(0.786)	(0.787)	(0.795)
Deposit to assets			-0.634**	-0.629**	-0.623**
			(0.255)	(0.254)	(0.256)
Gov. Support			0.125		
			(0.169)		
Gov. Sup. Dummy1				-0.107**	
				(0.052)	
Gov. Sup. Dummy2					-0.077
					(0.064)
Observations	44,349	44,198	44,198	44,198	44,198
R-squared	0.918	0.918	0.919	0.919	0.919
Bank FE	YES	YES	YES	YES	YES
Month FE	YES	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 8: Cost of Capital and Bank Size

This table presents estimated coefficients for various regressions with cost of capital as the dependent variable (in percentage points). Specification (1) to (3) is for the total cost of capital r^{Total}, specification (4) to (6) is for the cost of equity capital r^e, and specification (7) to (9) is for the cost of debt capital r^d. Deposits to assets is the book value of deposits to book value of asset. Government support measures the government's equity stake as a fraction of the total bank equity. Government support dummy1 is equal to 1 in the years where the government had an equity stake in the bank and 0 otherwise. Government support dummy2 is equal to 1 after a bank received government support and 0 before. The main regression variables have been interacted with indicators for large and small banks. Banks in the monthly top 20% of the asset size distribution is considered large and banks in the monthly bottom 20% are considered small banks. The regressions are calculated with cluster robust standard errors over bank and month. The regressions are with bank and month fixed effects.

VARIABLES	(1) r^{total}	(2) r^{total}	(3) r^{total}	(4) r^e	(5) r^e	(6) r^e	(7) r^d	(8) r^d	(9) r^d
Tier1 ratio	-1.003*	-0.892*	-0.893	-11.886***	-11.807***	-12.103***	-2.271***	-2.234***	-2.269***
	(0.536)	(0.529)	(0.542)	(1.838)	(1.836)	(1.828)	(0.624)	(0.620)	(0.631)
Tier2 ratio	0.550	0.545	0.611	-8.428***	-8.450***	-8.522***	1.389	1.394	1.376
	(0.831)	(0.833)	(0.841)	(2.610)	(2.612)	(2.602)	(1.077)	(1.075)	(1.077)
Deposit to assets	-0.541**	-0.536**	-0.528**	-0.214	-0.214	-0.240	-0.507*	-0.504	-0.507*
	(0.264)	(0.262)	(0.264)	(0.696)	(0.695)	(0.689)	(0.305)	(0.305)	(0.305)
Deposits to assets * Large	-0.180	-0.181	-0.184	-1.865***	-1.858***	-1.854***	-0.227	-0.232	-0.231
	(0.151)	(0.151)	(0.152)	(0.527)	(0.525)	(0.521)	(0.169)	(0.169)	(0.169)
Deposits to assets * Small	0.015	0.014	0.017	0.118	0.120	0.117	0.331	0.328	0.327
	(0.225)	(0.228)	(0.226)	(1.237)	(1.231)	(1.234)	(0.424)	(0.426)	(0.425)
Tier1 ratio * Large	0.971	0.931	0.979	9.331***	9.266***	9.307***	1.197	1.201	1.201
	(0.817)	(0.819)	(0.824)	(3.345)	(3.345)	(3.307)	(0.869)	(0.874)	(0.872)
Tier1 ratio * Small	-1.342	-1.465	-1.426	0.696	0.612	0.874	-4.418	-4.455	-4.428
	(1.218)	(1.220)	(1.222)	(5.646)	(5.640)	(5.645)	(2.720)	(2.735)	(2.731)
Tier2 ratio * Large	1.033	1.155	1.040	9.895***	10.022***	9.859***	-0.261	-0.238	-0.244
	(1.339)	(1.334)	(1.327)	(3.254)	(3.234)	(3.250)	(1.502)	(1.502)	(1.500)
Tier2 ratio * Small	0.030	0.101	0.027	-0.838	-0.768	-0.885	0.792	0.809	0.808
	(0.717)	(0.724)	(0.726)	(6.428)	(6.390)	(6.444)	(1.947)	(1.949)	(1.950)
Gov. Support	0.121			-0.497*			0.314***		
	(0.171)			(0.261)			(0.059)		
Gov. Sup. Dummy1		-0.110**			-0.153			-0.005	
		(0.053)			(0.176)			(0.063)	
Gov. Sup. Dummy2			-0.079			0.143			0.024
			(0.064)			(0.163)			(0.074)
Observations	44,198	44,198	44,198	46,349	46,349	46,349	44,198	44,198	44,198
R-squared	0.919	0.919	0.919	0.683	0.683	0.683	0.910	0.910	0.910
Bank FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Month FE	YES	YES	YES	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 9: Cost of Capital and Time Dependence

This table presents estimated coefficients for various regressions with cost of capital as the dependent variable (in percentage points). Specification (1) and (2) are for the total cost of capital r^{Total}, specification (3) and (4) is for the cost of equity capital r^e, and specification (5) and (6) is for the cost of debt capital r^d. Deposits to assets is the book value of deposits to book value of asset. Government support measures the government's equity stake as a fraction of the total bank equity. Government support dummy1 is equal to 1 in the years where the government had an equity stake in the bank and 0 otherwise. Government support dummy2 is equal to 1 after a bank received government support and 0 before. The interacted time indicators are 1 after the year stated in the name and 0 before. The regressions are calculated with cluster robust standard errors over bank and month. The regressions are with bank and month fixed effects.

VARIABLES	(1) r^{total}	(2) r^{total}	(3) r^e	(4) r^e	(5) r^d	(6) r^d
Tier1 ratio	-0.923	-0.835	-6.476***	-7.514***	-1.964***	-1.925***
	(0.637)	(0.598)	(1.503)	(1.458)	(0.739)	(0.691)
Tier2 ratio	1.078	1.285	-1.014	-2.165	1.026	1.277
	(1.025)	(0.933)	(2.165)	(2.150)	(1.117)	(1.069)
Deposit to assets	-0.676**	-0.641**	-0.426	-0.914	-0.688**	-0.627**
	(0.262)	(0.254)	(0.655)	(0.625)	(0.306)	(0.301)
Gov. Sup. Dummy1	-0.119**	-0.115**	-0.047	-0.093	-0.016	-0.012
	(0.050)	(0.050)	(0.169)	(0.175)	(0.062)	(0.062)
Deposits to assets x I(>= 2008)	0.380		-4.988***		0.591*	
	(0.272)		(0.951)		(0.324)	
Tier1 ratio x I(>= 2008)	1.291*		-6.226**		0.710	
	(0.775)		(2.933)		(0.927)	
Tier2 ratio x I(>= 2008)	-0.446		-8.758***		-0.017	
	(1.415)		(3.219)		(1.199)	
Deposits to assets x I(>= 2011)		0.606*		-4.071***		0.727*
		(0.319)		(0.966)		(0.425)
Tier1 ratio x I(>= 2011)		1.497*		-4.514*		0.954
		(0.859)		(2.590)		(0.979)
Tier2 ratio x I(>= 2011)		-1.106		-7.402**		-0.792
		(1.135)		(3.037)		(1.108)
Observations	44,198	44,198	46,349	46,349	44,198	44,198
R-squared	0.919	0.919	0.685	0.681	0.910	0.910
Bank FE	YES	YES	YES	YES	YES	YES
Month FE	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 10: Tier 1 Capital to Assets

This table presents estimated coefficients for various regressions with equity to assets as the independent variable. The regressions mimic those in Table 5 to 7 except that the tier 1 ratio has been replaced with tier 1 capital to assets. The regressions are calculated with cluster robust standard errors over bank and month. The regressions are with bank and month fixed effects.

VARIABLES	(1) r^{total}	(2) r^{total}	(3) r^{total}	(4) r^{e}	(5) r^{e}	(6) r^{e}	(7) r^{d}	(8) r^{d}	(9) r^{d}
Tier1 to assets ratio	-0.414	-0.225	-0.224	-9.546***	-9.343***	-9.833***	-4.540***	-4.532***	-4.554***
	(0.925)	(0.906)	(0.933)	(2.560)	(2.549)	(2.573)	(1.197)	(1.188)	(1.221)
Tier2 to assets	1.595	1.628	1.375	9.567*	9.839*	9.960*	-0.861	-0.985	-0.900
	(2.150)	(2.172)	(2.099)	(5.796)	(5.805)	(5.752)	(2.759)	(2.784)	(2.739)
Deposit to assets	-0.402	-0.406	-0.394	-0.297	-0.300	-0.308	-0.402	-0.403	-0.407
	(0.281)	(0.281)	(0.282)	(0.640)	(0.641)	(0.635)	(0.345)	(0.346)	(0.345)
Gov. Support	0.142			-0.486*			0.337***		
	(0.164)			(0.266)			(0.060)		
Gov. Sup. Dummy1		-0.113**			-0.193			0.027	
		(0.055)			(0.173)			(0.064)	
Gov. Sup. Dummy2			-0.085			0.121			0.032
			(0.065)			(0.176)			(0.072)
Observations	38,560	38,560	38,560	40,004	40,004	40,004	38,560	38,560	38,560
R-squared	0.915	0.915	0.915	0.645	0.645	0.645	0.901	0.900	0.900
Bank FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Month FE	YES	YES	YES	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 11: Equity to Risk-Weighted-Capital

This table presents estimated coefficients for various regressions with equity to assets as the independent variable. The regressions mimic those in Table 5 to 7 except that the tier 1 ratio has been replaced with equity capital to risk weighted asset (RWA). The regressions are calculated with cluster robust standard errors over bank and month. The regressions are with bank and month fixed effects.

VARIABLES	(1) r^{total}	(2) r^{total}	(3) r^{total}	(4) r^{e}	(5) r^{e}	(6) r^{e}	(7) r^{d}	(8) r^{d}	(9) r^{d}
Equity to RWA	0.569	0.525	0.639	-3.828**	-3.910**	-3.858**	-1.289**	-1.301**	-1.303**
	(0.453)	(0.456)	(0.441)	(1.922)	(1.930)	(1.885)	(0.524)	(0.532)	(0.518)
Deposit to assets	-0.396	-0.402	-0.383	-0.447	-0.459	-0.454	-0.425	-0.427	-0.427
	(0.282)	(0.282)	(0.283)	(0.626)	(0.627)	(0.622)	(0.348)	(0.349)	(0.347)
Gov. Support	0.139			-0.545*			0.320***		
	(0.159)			(0.311)			(0.063)		
Gov. Sup. Dummy1		-0.110**			-0.279			-0.014	
		(0.055)			(0.173)			(0.072)	
Gov. Sup. Dummy2			-0.097			0.056			0.009
			(0.065)			(0.168)			(0.075)
Observations	38,584	38,584	38,584	40,029	40,029	40,029	38,584	38,584	38,584
R-squared	0.915	0.915	0.915	0.643	0.643	0.642	0.900	0.900	0.900
Bank FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Month FE	YES	YES	YES	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 12: Equity to Assets

This table presents estimated coefficients for various regressions with equity to assets as the independent variable. The regressions mimic those in Table 5 to 7 except that the tier 1 ratio has been replaced with equity capital to assets. The regressions are calculated with cluster robust standard errors over bank and month. The regressions are with bank and month fixed effects.

VARIABLES	(1) r^{total}	(2) r^{total}	(3) r^{total}	(4) r^e	(5) r^e	(6) r^e	(7) r^d	(8) r^d	(9) r^d
Equity to assets	1.763**	1.729**	1.848**	-7.334***	-7.354***	-4.948**	-3.666***	-3.709***	-3.709***
	(0.711)	(0.706)	(0.717)	(1.675)	(1.683)	(2.130)	(1.037)	(1.047)	(1.033)
Deposit to assets	-0.930***	-0.926***	-0.901***	-0.958*	-0.955*	-0.341	-0.453	-0.456	-0.457
	(0.301)	(0.299)	(0.292)	(0.549)	(0.548)	(0.631)	(0.351)	(0.352)	(0.351)
Gov. Support	0.109			-0.517*			0.308***		
	(0.167)			(0.310)			(0.070)		
Gov. Sup. Dummy1		-0.122**			-0.221			-0.018	
		(0.054)			(0.179)			(0.071)	
Gov. Sup. Dummy2			-0.148*			0.059			0.011
			(0.084)			(0.173)			(0.072)
Tier2 to assets						10.529*	-0.486	-0.571	-0.560
						(6.003)	(2.739)	(2.764)	(2.709)
Observations	49,041	49,041	49,041	51,472	51,472	40,004	38,560	38,560	38,560
R-squared	0.911	0.912	0.912	0.673	0.673	0.642	0.901	0.900	0.900
Bank FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Month FE	YES	YES	YES	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 13: Regulatory CET1 ratio

This table presents estimated coefficients for various regressions with equity to assets as the independent variable. The regressions mimic those in Table 5 to 7 except that the tier 1 ratio has been replaced with the regulatory CET1 ratio. This means that the data sample only starts in 2014 when the ratio starts to be listed in the financial statement. The regressions are calculated with cluster robust standard errors over bank and month. The regressions are with bank and month fixed effects.

VARIABLES	(1) r^{total}	(2) r^{e}	(3) r^{d}	(4) r^{total}	(5) r^{e}	(6) r^{d}
CET1 ratio	0.656	-10.455*	-0.554**			
	(1.442)	(5.429)	(0.229)			
Deposit to assets	0.043	-0.454	-0.181	0.031	-0.258	-0.172
	(0.375)	(3.108)	(0.143)	(0.390)	(3.136)	(0.141)
CET1 bufferW				0.773	-9.371*	-0.477**
				(1.381)	(5.377)	(0.214)
Observations	1,724	1,749	1,724	1,724	1,749	1,724
R-squared	0.948	0.856	0.988	0.948	0.856	0.988
Bank FE	YES	YES	YES	YES	YES	YES
Month FE	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses

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

Table 14: Regressions without Bank Fixed Effects.

This table presents estimated coefficients for various regressions with equity to assets as the independent variable. The regressions mimic those in Table 5 to 7 except that the regressions in this table are without bank fixed effects. Instead the regressions add the ratio of assets to risk-weighted-assets (RWA). The regressions are calculated with cluster robust standard errors over bank and month. The regressions are with bank and month fixed effects.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES	r^{total}	r^{total}	r^{total}	r^{e}	r^{e}	r^{e}	r^{d}	r^{d}	r^{d}
Tier1 ratio	1.782	1.798	1.793	-5.003**	-4.989**	-5.009**	-1.468	-1.558	-1.458
	(1.696)	(1.705)	(1.687)	(2.473)	(2.493)	(2.474)	(1.282)	(1.293)	(1.276)
Tier2 ratio	0.892	0.901	0.856	-2.168	-2.163	-2.185	-1.033	-1.097	-1.055
	(1.939)	(1.945)	(1.927)	(3.065)	(3.071)	(3.061)	(1.700)	(1.704)	(1.689)
Deposit to assets	-1.796***	-1.801***	-1.814***	-1.755**	-1.764**	-1.767**	-1.914***	-1.921***	-1.922***
	(0.319)	(0.319)	(0.315)	(0.768)	(0.769)	(0.773)	(0.306)	(0.308)	(0.305)
Assets to RWA	-0.390***	-0.392***	-0.401***	-0.245	-0.248	-0.248	-0.089	-0.080	-0.097
	(0.147)	(0.148)	(0.145)	(0.215)	(0.214)	(0.214)	(0.129)	(0.130)	(0.128)
Gov. Support	-0.124**			-0.221			-0.016		
	(0.055)			(0.398)			(0.241)		
Gov. Sup. Dummy1		-0.029			-0.033			0.127**	
		(0.045)			(0.202)			(0.053)	
Gov. Sup. Dummy2			-0.177***			-0.033			-0.122***
			(0.044)			(0.156)			(0.047)
Observations	35,079	35,079	35,079	36,317	36,317	36,317	35,079	35,079	35,079
R-squared	0.815	0.815	0.816	0.358	0.358	0.358	0.783	0.784	0.784
Bank FE	NO	NO	NO	NO	NO	NO	NO	NO	NO
Month FE	YES	YES	YES	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 15: Capital Buffer Correlations

This table presents correlation estimates between various bank capital buffers. For each capital requirement that the bank faces there is a capital requirement and a well-capitalized requirement. The buffer is in each case calculated as the distance between the measure and the requirement. Both measure and requirement are given as ratios. The distance for to the capital requirement is marked with an R and the distance to the well-capitalized requirement is marked with an W. Total risk capital is the sum of the tier1 and tier2 capital.

Variables	1	2	3	4	5	6	7	8
1. Tier1 to assets ratio bufferR	1.000							
2. Tier1 to assets ratio bufferW	1.000	1.000						
3. Total risk capital bufferR	0.735	0.735	1.000					
4. Total risk capital bufferW	0.735	0.735	1.000	1.000				
5. CET1 bufferW	0.784	0.784	0.954	0.954	1.000			
6. CET1 bufferR	0.788	0.788	0.951	0.951	0.997	1.000		
7. Tier1 ratio bufferR	0.724	0.724	0.948	0.948	0.966	0.970	1.000	
8. Tier1 ratio bufferW	0.726	0.726	0.949	0.949	0.969	0.967	0.998	1.000

Table 16: Cost of Capital and Capital Buffers

This table presents estimated coefficients for various regressions with cost of capital as the independent variable (in percentage points). Specification (1) and (4) is for the total cost of capital r^{Total}, specification (2) to (5) is for the cost of equity capital r^e, and specification (3) to (6) is for the cost of debt capital r^d. Deposits to assets is the book value of deposits to book value of asset. The first set of regressions uses the CET1 ratio and the CET1 buffer to the well-capitalized requirement. The second set of regressions uses the same but for tier1 capital. The regressions are calculated with cluster robust standard errors over bank and month. The regressions are with bank and month fixed effects.

VARIABLES	(1) r^{total}	(2) r^e	(3) r^d	(4) r^{total}	(5) r^e	(6) r^d
CET1 ratio	-2.960	-22.524**	-1.625**			
	(1.731)	(8.453)	(0.657)			
Deposit to assets	-0.021	-0.658	-0.200	-0.390	-0.592	-0.358
	(0.374)	(3.151)	(0.146)	(0.299)	(0.642)	(0.371)
CET1 bufferW	3.563***	11.885**	1.055*			
	(0.642)	(5.535)	(0.579)			
Tier1 ratio				-1.905	-2.191	-3.511***
				(1.163)	(3.062)	(1.307)
Tier1 ratio bufferW				1.121	-5.309*	1.462
				(1.038)	(2.995)	(1.140)
Observations	1,724	1,749	1,724	36,018	37,303	36,018
R-squared	0.949	0.857	0.989	0.914	0.649	0.899
Bank FE	YES	YES	YES	YES	YES	YES
Month FE	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 17: Tax Shield Ratio

This table presents estimated coefficients for the tax shield ratio in percentage points. Tax shield is the estimated present value of the future tax savings due to interest payments. The tax shield is then divided by the total asset value to form a ratio. In the columns labeled Federal the tax shield is calculated assuming a federal tax rate. In the other columns the tax shield is calculated using a company specific tax rate derived from last years tax payments. The explanatory variables are the same as in Table 9. The regressions are calculated with cluster robust standard errors over bank and year. The regressions are with bank and year fixed effects.

VARIABLES	(1) *Federal*	(2) *Federal*	(3) *Firm*	(4) *Firm*
Tier1 ratio	-19.238***	-22.662***	-21.827***	-29.020***
	(4.265)	(4.168)	(8.085)	(7.951)
Tier2 ratio	-5.872	-6.208	1.698	1.522
	(4.338)	(4.237)	(15.428)	(15.123)
Deposit to assets	-4.175***	-4.181***	-0.646	-0.499
	(1.594)	(1.513)	(2.562)	(2.466)
Gov. Sup. Dummy1	1.745***	1.755***	1.949**	2.046**
	(0.490)	(0.479)	(0.886)	(0.884)
Deposits to assets x I(>= 2008)	-3.981		-4.755	
	(2.769)		(4.078)	
Tier1 ratio x I(>= 2008)	-14.846**		-6.578	
	(6.378)		(16.620)	
Deposits to assets x I(>= 2011)		-11.170***		-16.324***
		(3.639)		(5.862)
Tier1 ratio x I(>= 2011)		-8.210		13.674
		(6.666)		(17.428)
Observations	45,814	45,814	39,190	39,190
R-squared	0.907	0.908	0.756	0.758
Bank FE	YES	YES	YES	YES
Month FE	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 18: The Effect of a Higher Capital Ratio

The table shows the effect of increasing the tier 1 capital ratio by extrapolating from the regressions in Table 5 (specification (3)), 6 (specification (6)), 7 (specification (3)), and 17 (specification (2)). The first panel shows the effect of increasing the tier1 ratio while holding other regression variables constant. The second part of each panel shows the effect of increasing the tier1 ratio while decreasing the deposit ratio. Panel B shows the effect after 2011, where estimates are based on those from Table 9. The change in loan rate are derived from the increase in WACC for the average bank. The estimates after 2011 for the loan rate applies the total cost of capital at the end of the sample.

Panel A: Entire Period	Δr^e	Δr^d	Δr^{Total}	Δ TaxShield	Δ Loan rate (bps)
ΔTier1 ratio = 2.5%	-0.20	-0.05	-0.02	-0.57	2.13
ΔTier1 ratio = 10%	-0.79	-0.18	-0.06	-2.27	8.47
ΔTier1 ratio = -ΔDep ratio = 2.5%	-0.17	-0.03	0.00	-0.46	1.72
ΔTier1 ratio = -ΔDep ratio = 10%	-0.68	-0.12	0.00	-1.85	6.91

Panel B: After 2011	Δr^e	Δr^d	Δr^{Total}	Δ TaxShield	Δ Loan rate (bps)
ΔTier1 ratio = 2.5%	-0.30	-0.02	0.02	-0.77	1.16
ΔTier1 ratio = 10%	-1.20	-0.10	0.07	-3.09	4.64
ΔTier1 ratio = -ΔDep ratio = 2.5%	-0.18	-0.03	0.02	-0.38	0.57
ΔTier1 ratio = -ΔDep ratio = 10%	-0.70	-0.11	0.07	-1.55	2.33

Figure 1: The cost of equity capital for banks

This figure shows the cost of equity capital for banks over the period 1993-2016. The mean estimate is across all banks in that given month. The figure also shows the 10% and 90% percentiles in the monthly distribution. The cost of equity is calculated using the ICC estimate based on analyst earnings forecast.

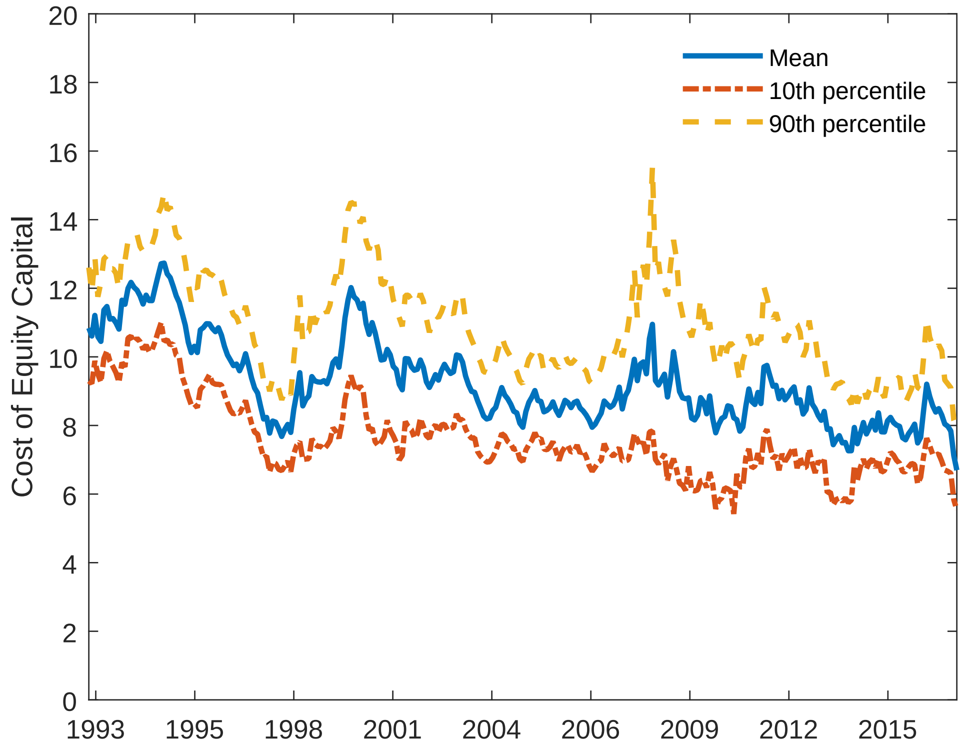

Figure 2: The cost of debt capital for banks

This figure shows the cost of debt capital for banks over the period 1993-2016. The mean estimate is across all banks in that given month. The figure also shows the 10% and 90% percentiles in the monthly distribution. The cost of debt is calculated using the individual bank's interest payments over the last year.

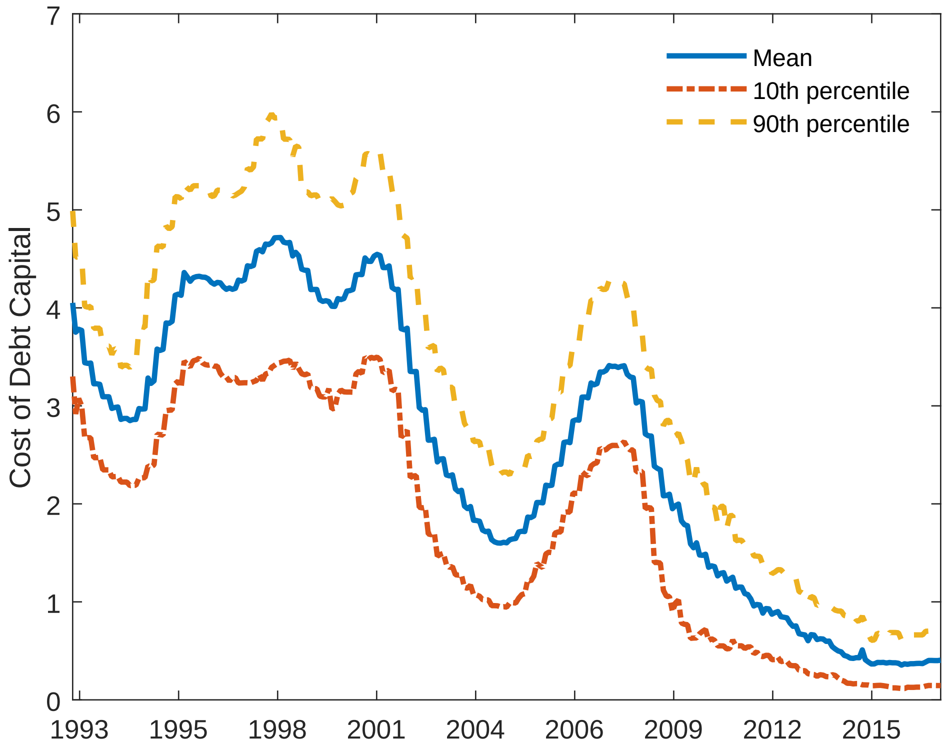

Figure 3: The capital structure of banks

This figure shows the capital structure for banks over the period 1993-2016. The graphs are for the Tier1 ratio, the tier2 ratio, deposits to total assets, and for equity to total assets. The mean estimate in each figure is across all banks in that given year. The figures also show the 10% and 90% percentiles in the monthly distribution of each ratio.

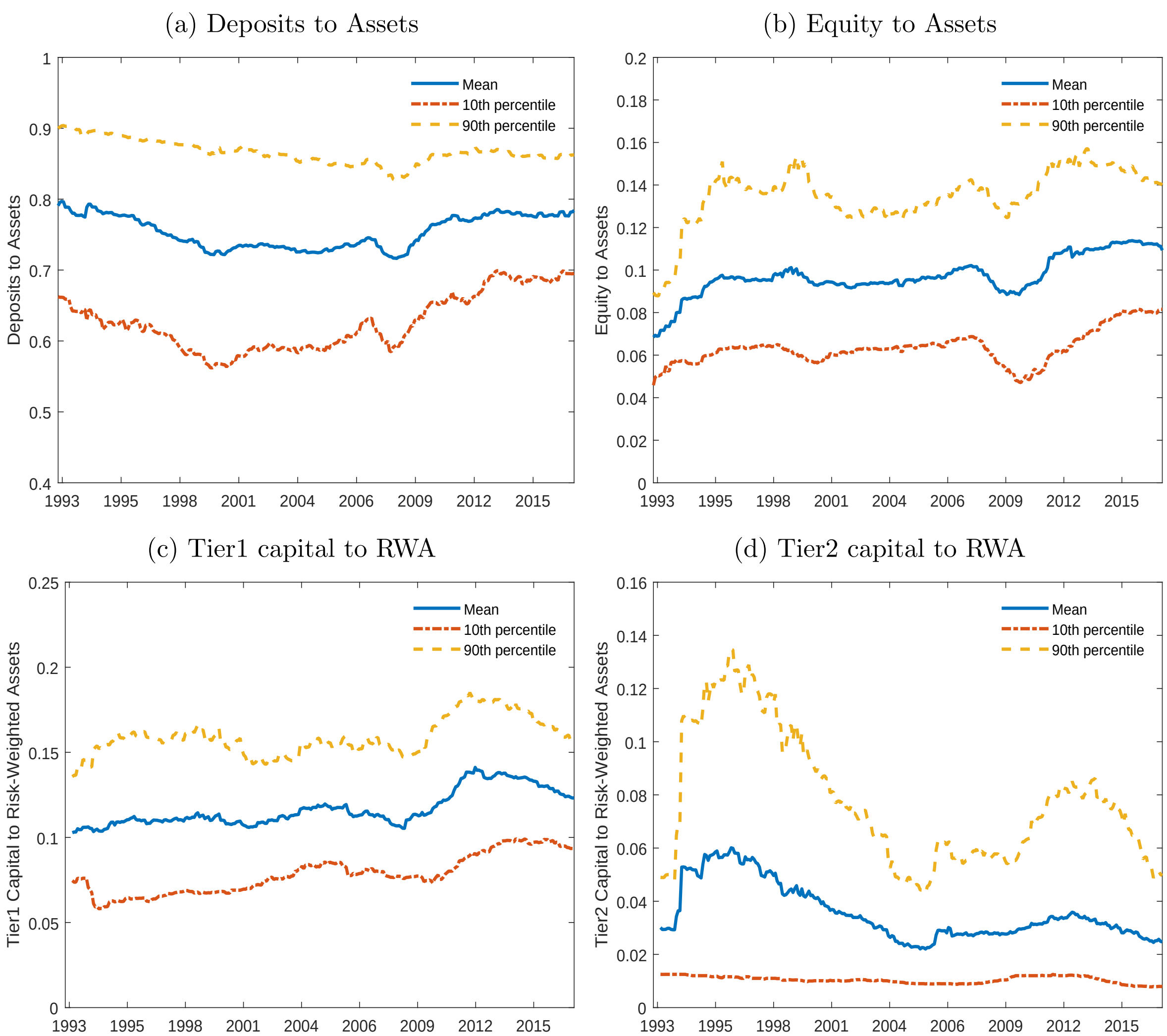

Figure 4: The total cost of capital for banks

This figure shows the total cost of capital for banks over the period 1993-2016. The mean estimate is across all banks in that given month. The figure also shows the 10% and 90% percentiles in the monthly distribution. The total cost of capital is the weighted average of the equity and debt cost of capital weighted by the size of the equity and debt. The equity cost of capital is based on the ICC estimate from analyst earnings forecasts and debt cost of capital is based on the individual bank's interest payments over the last year.

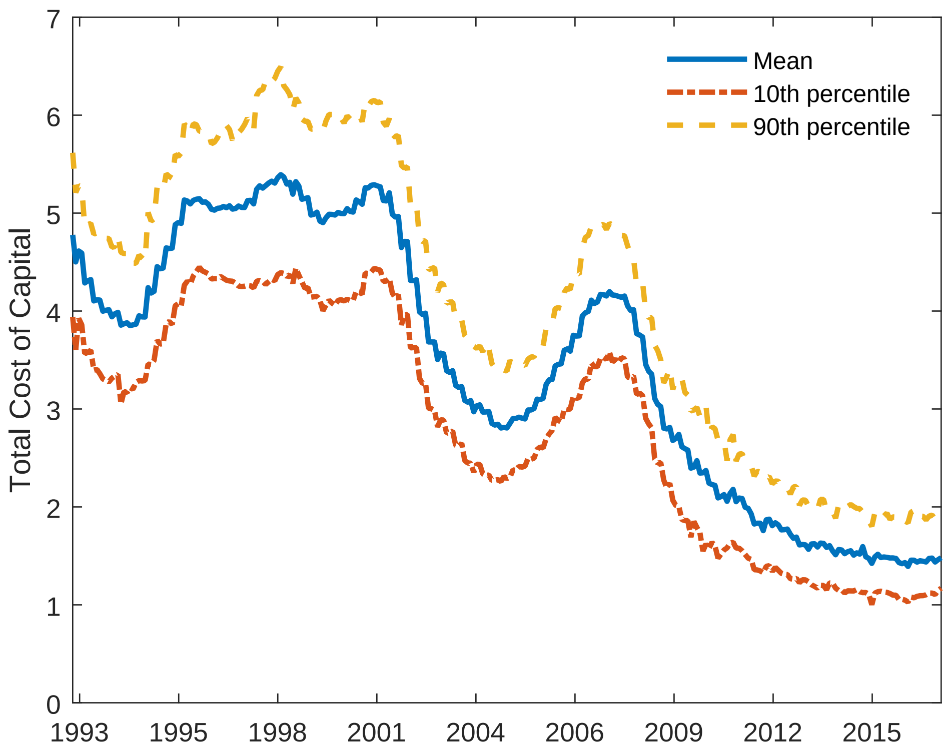

Figure 5: The tax shield ratio for banks

This figure shows the tax shield ratio for banks over the period 1993-2016. The tax shield is calculated using the individual bank's interest payments and a federal tax rate. The present value of the tax shield has been found by discounting with the total cost of capital. The tax shield ratio is the tax shield to total assets. The mean estimate is across all banks in that given month. The figure also shows the 10% and 90% percentiles in the monthly distribution.