The Cost of Capital for Banks*

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December 16, 2019

Abstract

We use analyst earnings forecasts to extract cost of capital measures for banks. Both the cost of equity and debt capital are decreasing in the tier 1 ratio, whereas total cost of capital is independent of the tier 1 ratio. Our findings suggest that investors adjust their expectations in accordance with the conservation of risk principle (Modigliani and Miller, 1958), also around episodes of equity issuances. Extrapolating from our results; a 10 pp increase in the tier 1 ratio is associated with a 2-8 bps increase in customer borrowing rates due to a loss of tax shield. Finally, we find that increased deposits and off-balance sheet liabilities tend to lower total cost of capital.

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

*Thanks to Morten Bech, Ken Bechmann, Andreas Fuster, Kristian Kjeldsen, David Lando, Lasse Heje Pedersen, Jesper Rangvid, Carsten Tanggaard, Tara Rice, and seminar participants at Tsinghua University, the Bank for International Settlements, the Swiss National Bank, Danish Central Bank, University of Copenhagen, Danish National Research Foundation meeting, 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 Gyntelberg was a guest researcher at 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 form of equity is expensive for the banks. If equity funding is indeed expensive, then increased capital requirements comes at a cost for the banks. The main theoretical argument for why equity funding might not be expensive is the conservation of risk principle from Modigliani and Miller (1958). Our main contribution is to show empirically that investors do adjust their return expectations for banks in accordance with the conservation of risk principle.

We use analyst earnings forecasts to extract cost of capital measures for banks.[1] These measures can be regarded as market expectations (see e.g So (2013)) and performs well when comparing expected and realized returns. Using these measures, we show that the cost of equity and debt capital are decreasing in the tier 1 ratio. Hence, banks with higher levels of the tier 1 ratio also tends to have lower expected equity returns consistent with the conservation of risk principle. According to the principle, higher levels of equity should decrease the riskiness of equity and debt but maintain the overall level of risk within the bank. We verify this by looking at the total cost of capital, which is defined as the portfolio-weighted average of the cost of equity and debt. We find that the total cost of capital is independent of the tier 1 ratio but can be explained by the asset risk of the bank.

Prior studies have used the capital asset pricing model to estimate the cost of equity capital (see e.g. King (2009), Miles, Yang, and Marcheggiano (2013), and Kashyap, Stein, and Hanson (2010)). These studies find a partial offset in the cost of equity capital for banks with higher levels of tier 1 ratios. This means that increasing

[1] See e.g., Claus and Thomas (2001), Gebhardt, Lee, and Swaminathan (2001), Easton (2004), Ohlson and Juettner-Nauroth (2005)).

the tier 1 ratio does reduce the equity risk but not enough to be consistent with the conservation of risk principle (Modigliani and Miller (1958) and Miller (1995)). We deviate from these earlier studies by looking at the total cost of capital and showing that the total cost of capital is independent of the tier 1 ratio suggesting a full offset in equity riskiness for higher levels of tier 1 ratios. The capital asset pricing model approach has also been criticized in Baker and Wurgler (2015). They show that bank equity returns exhibit a low risk anomaly with respect to the equity beta. Hence, a portfolio sort of bank stocks on their equity beta shows that there is almost no relationship between beta and realized returns. We replicate the same exercise within our data and also find a strong low risk anomaly with respect to the equity beta, i.e., low beta stocks realize the same average return as high beta stocks. However, when we sort on the expected return based on analyst earnings forecast, we find that investors are able to distinguish between low return banks and high return banks. By looking directly at the cost of capital implied by analyst earnings forecasts, we abstract from defining the exact relationship between risk and returns as has been done in earlier studies and we instead take the outcome of the investors' implicit risk and return modelling as given.

Furthermore, we deviate from earlier papers in two additional ways. First, we use a bank specific cost of debt capital. Second, we control for the bank's individual level of asset risk. The main approach in earlier papers have been to assume that bank debt is risk free and that it therefore is expected to earn the risk free rate. By assuming a risk free rate for bank debt, the prior papers by assumption get that the conservation of risk principle cannot hold for banks, because according to the principle the cost of debt capital should be increasing in the leverage of the bank. We use realized interest expenses to derive a measure of the debt cost of capital and show that this measure is lower for banks with higher tier 1 ratios. This finding suggest that banks do get a discount on their borrowing rates when they have higher tier 1 ratios. The finding is consistent with banks wanting to obtain good ratings before getting funding from debt markets. In addition to a bank specific measure of debt costs, we also control for differences in the asset risk between banks. Performing a portfolio sort on the tier 1 ratio, results in the same low risk anomaly as in Baker and Wurgler (2015). However, two banks could have the same leverage ratios but different business models resulting in different levels of asset risk. The negative relationship between leverage and equity returns predicted by the conservation of risk principle is thus conditional on the level of asset risk.

The tier 1 ratio is given as the total tier 1 capital to risk weighted assets. Admati and Hellwig (2013) argue that this measure might be subject to manipulation by the banks. Our results suggest that investors do differentiate banks based on the tier 1 ratio and that they therefore do put some confidence into the measure. As a robustness test, we show that using the total tier 1 capital to total assets, i.e., the book leverage ratio, or using the CET1 ratio gives similar results. We also hand-collect capital requirements for each bank in our sample as given in their financial statements. Using these capital requirements, we calculate the distance to the capital requirement, i.e., the size of the buffer, and show that we can obtain similar results by using the buffer size instead of the raw ratio. However, because there is very little cross-sectional variation in the capital requirements, we cannot distinguish the effect of the raw ratio from the buffer size as they are very highly correlated.

Our sample includes all US banks over the period from 1993-2016 and covers a total of 1,758 banks. Most of these banks rely heavily on deposit funding. We find that banks with higher levels of deposit funding have lower total cost of capital. This suggest that deposit funding can be considered cheap funding from the perspective of the bank. We show that the effect is primarily driven by demand deposits as opposed to time deposits. For demand deposits, depositors seem to be willing to accept a low deposit rate consistent with depositors valuing the liquidity service provided by the bank (see e.g. Allen, Carletti, and Marquez (2015) and DeAnglo and Stulz (2015)). However, we also find larger amounts of insured time deposits lower the total cost of capital indicating that depositor insurance have an effect on the banks funding rates. Another source of cheap funding for the banks is off-balance sheet liabilities. Higher levels of off-balance sheet liabilities tend to lower the total cost of capital while increasing the cost of equity capital. From the perspective of equity holders off-balance sheet liabilities are essentially debt (Borio, MacCauley, and McGuire (2017)), which need to be serviced before equity. It is primarily larger banks which engage in off-balance sheet activities but we find no difference in general between large and small banks. Investors adjust their return expectations in accordance with the conservation of risk principle for both large and small banks.

Our results can be seen as a form of equilibrium description of capital costs in the sense that on average investors adjust their expected return in accordance with the conservation of risk principle. In order to get more insights into the effect of a change in capital requirements, we look at instances of equity issuance as in Baron (2019) and link them to changes in capital requirements. If equity is expensive and banks issuing equity is subject to a lemons effect as in the pecking order theory (Jensen and Meckling (1976)) then we should expect to see an increase in the total cost of capital after an equity issuance. However, on average we find a statistically insignificant and negative effect on the total cost of capital when a bank issue equity. These results are thus inconsistent with equity funding being expensive but still consistent with the conservation of risk principle. Conditioning specifically at issuances following an increase in capital requirements, we find the same results that issuing equity does not result in an increased cost of capital. The issuance of equity after an increase in capital requirements should not be subject to asymmetric information because all parties know that the issuance is in response to the higher capital requirements. We do, however, find that the total cost of capital temporarily increases following an increase in capital requirements. All else equal, higher capital requirements decrease the distance to the capital requirement and increase the risk that the bank will be sanctioned by regulators. The effect on the total cost of capital vanishes after approximately 6 months. This is likely a result of the banks responding to the increase in requirements by either issuing additional equity or by reducing their risk weighted assets, which in turn increase their tier 1 ratio (see e.g. Kovner and van Tassel (2019) and Favara, Ivanov, and Rezende (2019)).

When we find that the total cost of capital is independent of the leverage ratio, it is from the perspective of an investor holding all the equity and debt issued by the firm. This investor would not change the required rate of return on the combined portfolio because of the risk conservation. However, reducing the leverage will affect how the bank can obtain the investor's required rate of return. Specifically, the bank will lose part of their tax shield and has to find another way of making up for this loss. The standard assumption in the related literature is to assume that the loss of tax shield will be cancelled out by an equally large increase in customer borrowing rates. This exercise would leave the weighted average cost of capital (WACC) for the bank unchanged. Extrapolating from our results, we show that a 10 pp increase in the tier 1 ratio would therefore increase customer borrowing rates by 2-8 bps. This number is far smaller than the corresponding number found in Kashyap, Stein, and Hanson (2010) and Baker and Wurgler (2015), which goes as high as a 90 bps increase. The result is also highly dependent upon the general interest rate level and is currently in the low range according to our regression results.

Our methodology separates the expected performance of the bank from the value of the bank. This separation is also done in, e.g., Baker and Wurgler (2015). Hence, when we evaluate if equity funding is expensive it is specifically in terms of expected returns. Equity funding might be expensive for banks in some other way, which is not captured by investors' return expectations. However, our paper provides a valuable input to the current debate by showing that a few changes in the assumptions underlying earlier studies reverse previous conclusions regarding the conservation of risk principle and the low risk anomaly for banks.

2 Estimating expected returns

In order to assess the impact of differences in bank equity capital, we study the relationship between expected returns and leverage for banks. Expected returns should reflect how risky investors consider a bank to be. A positive difference in perceived risk should translate into a higher expected return, which would require the bank to earn a higher return on its capital to satisfy 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, required 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 any 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.[2]

In our main analysis we use median values of analyst earnings estimates to mitigate the impact of outliers.[3] We perform our estimations by combining the IBES data available at the first trading day of each month starting in 1994 with the most recently available accounting data. That is, we use the most recently known values from IBES and the most recently known 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

[2]Table A1 in the internet appendix lists the accounting variables and their names in Compustat. Furthermore, the table also lists variables from CRSP, IBES and other data sources.

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

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 (see Mohanram and Gode (2013)). In the accounting literature the expected equity return is usually called the implied-cost-of-capital (ICC). This measure has also been used previously in the finance literature, see e.g., Pastor, Sinha, and Swaminathan (2008) and Chava (2014). 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.

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 of the realized returns. The main estimate of expected returns on equity capital in this study is therefore an equally-weighted average of the four most commonly used ICC measures,[4] 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 has 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

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

estimates. Even though both of these methods have shown some (sparsely) 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 unadjusted 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 in Table 1. 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), Cline (2015), and Kovner and van Tassel (2019) all use the CAPM when estimating the expected return. Baker and Wurgler (2015) show that if the stock beta is the appropriate risk measure then bank stocks exhibit a low risk anomaly. This result indicates that the CAPM cannot be used to calculate the equity cost of capital for banks. With the low risk anomaly from Baker and Wurgler (2015) there is essentially no connection between the beta risk measure and realized equity returns. In Table 2 we compare the performance of the ICC measure against the approach from Baker and Wurgler (2015). We form bank stock portfolios pre-ranked on either ICC, forward beta[5] as in Baker and Wurgler (2015), or the tier 1 capital ratio. Each

[5]The forward beta is calculated using realized returns over the next 24-60 months.

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 given month all three of ICC, forward beta, and tier 1 capital ratio 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 2 shows the average monthly returns of the five portfolios together with average characteristics at the time of the pre-ranking. Panel A of Table 2 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 the portfolio 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. The average ICC estimates are somewhat lower than the realized returns, which is partially driven by the forward looking bias conditioning on the firm being alive in the next 24-60 months. In Panel B of Table 2 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). Finally, the relationship between tier 1 capital ratios and expected returns is very flat in our sample as can also be seen in Panel C of Table 2. 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 get a lower beta, but receive no discount in expected returns as they should according to theory.[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 that the ICC measure should already take into account. 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. The results indicate that investor's are able to explain the low-risk anomaly and take account of it in their forecasts (see e.g. Schneider, Wagner, and Zechner (2018)).

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. Prior papers have for simplicity assumed that bank debt on average is risk free and therefore earns the risk free rate of return. We take a different approach and obtain a bank specific cost of debt by looking at the realized interest expenses as reported by the banks in their financial statements. That is, we compute a forward looking cost of debt measure as the total interest paid over the next four quarters divided by the average total debt obligations over the beginning of each quarter. We lag the debt obligations by one quarter in

[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.

order to capture that the interest payments have been generated by the debt in place at the beginning of the quarter. As an alternative we also calculate the corresponding historical or backward looking measure of the cost of debt by looking over the last four quarters. The two methods give very similar results but we use the forward looking measure because we find it realistic that interest expenses can be predicted over the next year for the bank. Formally, we compute the cost of debt capital for bank i at time t as:

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

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 further 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 1 and Figure 2 show the monthly distribution of the cost of debt capital estimates. The estimated debt costs have 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. 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 should reflect the overall firm risk. It is thus the expected return that when used to discount all of the firm's future cash flows returns total firm value. By decomposing r_{it}^{total} with respect to individual risk characteristics, 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 expected return reflecting 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 the expected return reflecting risk associated with leverage, and finally

$\frac{L_{i,t}}{V^l_{i,t}}$ is the fraction of net benefits from leverage to firm value. Combining Equation (3) and Equation (4) shows that any net benefits of leverage for the individual banks 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, as already mentioned when discussing expected equity returns and the low-risk anomaly, 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 differences in tier 1 capital ratios and banks' funding costs. Theoretically, we would expect to see that the cost of equity capital and debt capital are lower for banks using more equity funding, i.e., more loss absorbing capital. If the conservation of risk principle holds then the total cost of capital should not be affected by the level of leverage but rather by the asset risk. 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.[7] All regressions are estimated with cluster robust standard errors, clustered by bank and month (see e.g. Petersen (2009)).

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 3 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

[7]In Table A2 in the internet appendix, we show the basic regressions where the month fixed effects have been replaced by the 8 macroeconomic factors from Welch and Goyal (2008). The results are robust to replacing the month fixed effects.

tier 1 ratio. The deposit ratio has an insignificantly negative estimate.

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 (preferred shares + common equity). 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 do not become significant. The signs indicate a minor decrease in equity risk for banks that receive government support. On top of the bank specific effect there could also be an effect on the overall economy from general government support, which is hidden in the time fixed effects.

In the last specification we include off-balance sheet liabilities. These are taken from the Bank Regulatory database and is not present for all banks, which is why the sample size is reduced. We expect that banks with access to derivative markets use these market when it is in their interest, i.e., when it reduces the (total) cost of capital for the bank (Borio, MacCauley, and McGuire (2017)). Most banks in our sample do not have any off-balance sheet liabilities as can be seen in Table 1, but off-balance sheet liabilities tend to increase equity risk for those banks that do use it. This is consistent with off-balance sheet liabilities resembling debt from the perspective of the equity holders. Furthermore, off-balance sheet liabilities have higher priority in case of bankruptcy than equity.

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 4 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 lowers, all else equal, which should result in lower interest payments as seen in the regression. This result contradict the approach from earlier papers where bank debt is assumed to be risk free (see e.g.Baker and Wurgler (2015)). 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 provides a cheaper source of funding than ordinary debt (we explore this issue further in section 3.8). Finally, receiving government support during the 2008 financial crisis did not do much to the interest payments. If anything, the effect points to higher costs of debt. Finally, we see that the use of off-balance sheet liabilities tend to lower the cost of debt. This finding is consistent with off-balance sheet liabilities being used as a form of low cost debt.

In the first five 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 the last specification. Results are similar across the sample with or without analyst earnings forecasts.

3.3 Total cost of capital

Table 5 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 together with those for the cost of equity and debt are consistent with the principle of conservation of risk (Modigliani and Miller, 1958). Changing the capital structure does not empirically 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, there is a loss of tax shield, which impacts how the bank can generate the return to satisfy investors (Kashyap, Stein, and Hanson, 2010). However, as can be seen from Table 5, changing capital structure does not affect the total cost of capital. 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 is thus when equity is replacing ordinary debt.

There is also a minor effect of government support on the total cost of capital. Banks where the government had an preferred equity stake following the 2008 crisis in general receive a discount on their overall funding rate. However, the effect is economically small. Finally, we see that banks using off-balance sheet liabilities tend to decrease their total cost of capital.

3.4 Bank size and time dependence

It is reasonable to believe that large banks and small banks may exhibit differences in how investors form their return expectations. 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.

In Table 6 we look into the difference in the cost of capital for small versus 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. This effect is (insignificantly) 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. However, deposit funding does decrease the total cost of capital across 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.[8]

[8]In unreported results, we have also run the regression for the 10 largest banks and the 10 smallest banks separately. The size and sign of the coefficient are close to those from Table 6, but

In Table 7 the main regressions 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 remains neutral and the effect on the total cost of capital decreases. The results still indicate that investors both before and after the crisis and the low interest rate environment continue to adjust their return expectations in accordance with the conservation of risk principle (Modigliani and Miller, 1958).

3.5 Other capital ratios

Critics of the current regulatory focus on tier 1 capital to risk-weighted assets, has 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 to use the leverage ratio for capital requirements, i.e., the tier 1 capital to total assets. The Basel III regulation has also introduced other capital requirements, e.g., a minimum ratio for the common equity tier 1 ratio (CET1). In Table 8, we substitute the tier 1 ratio for various other variations of bank leverage.

Most US banks has to fulfil a leverage requirement based on tier 1 capital to total assets. Consistent with the earlier findings in this paper, we see in Table 8 that equity

the reduction in sample size decrease the statistical power of the significance tests.

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.

Table 8 also includes bank leverage as measured by common equity (i.e. more than just tier 1 capital) to risk-weighted assets (RWA) and measured as common equity to total assets. Again, increasing the level of equity funding decrease 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 costs. The ex-ante expected relationship between funding costs and common equity is thus not well determined. This is also 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 9 we, again, get the same pattern that more equity funding decreases equity and debt funding costs but that the total funding costs remains 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. Table 9 also substitutes the CET1 ratio with the distance between the CET1 ratio and the capital requirement for the individual bank, i.e., the size of the buffer. 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.[9]

3.6 Asset volatility

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

We measure asset volatility as the ratio of risk-weighted assets to total assets. If the bank asset portfolio is risky, we would expect this measure to be high (close to 1) and if the bank has safe assets it should be low (close to 0). Table 10 show the main regressions with this asset risk measure included. Consistent with conservation of risk principle, 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. All else equal, higher asset risk should also increase the cost of equity and debt capital, which we also find in the regression. Hence, asset risk is important for the cost of capital as expected from the theory and, furthermore, the bank fixed effects does capture some important idiosyncratic bank characteristic.

[9]In Table A3 of the internet appendix, we show the correlations between capital buffers and buffers based on the well-capitalized requirement. All these correlations are very high making it difficult to distinguish between the effect of the various buffers. Furthermore, the level of the ratio and the buffers are also highly correlated.

3.7 Equity issuance and the cost of capital

In order to get a better identification of the effect of higher capital requirements and the effect of equity issuance, we augment the regressions with indicators for these events. We measure equity issuance and equity repurchases as in Baron (2019). Table 11 specification (4) to (6) shows the regressions with monthly observations and specification (1) to (3) is with quarterly observations. The issuance and repurchase indicators are 1 in the fiscal quarters where the bank respectively did either of those things. From the conservation of risk principle (Modigliani and Miller (1958)) there should be no separate effect on the cost of capital from a change in capital structure. However, if equity funding is expensive as suggested by the banks themselves and by the Pecking Order theory (Modigliani and Miller (1958)), issuing equity will increase the (total) cost of capital.

Looking at the monthly observations we find no effect of either equity issuances or repurchases consistent with the conservation of risk principle and inconsistent with these actions sending an adverse signal to market participants. In the quarterly regressions, we also include indicators for when the individual banks have their capital requirements increased. The indicator for an increase in capital requirement is based on the quarterly financial report where the bank for the first time mentions an increased capital requirement. Looking at equity issuances following an increase in capital requirements, should reduce any potential asymmetric information regarding why the bank chooses to issue equity.

The effect of an increase in capital requirements, all else equal, is that the total cost of capital increases temporarily in the 0-6 months following the increase. If the bank does nothing in response to the increase in requirements, the bank increases the risk that they will end up below the requirement at some point. This effect can explain the temporary increase in total cost of capital. We know from other papers that banks do respond to tighter regulation (see e.g. Kovner and van Tassel (2019) and Favara, Ivanov, and Rezende (2019)) and this reaction can explain why the increase is only temporarily. Specifically, we cannot find any adverse effect for the banks that issue equity in response to the increase in capital requirements. The indicator (Issuance Dummy 0-6) is 1 if the bank issues equity in the 0-6 months following an increase in requirements and 0 otherwise. All interactions with this indicator are insignificant in the regressions. Interestingly, the cost of debt capital are higher both before and after an increase in requirements. This could reflect that the increase in requirements are to some extent endogenous to the health of the bank.

3.8 Deposit type and the cost of capital

In most of the former regressions, we find that deposit funding is cheap in the sense that the total cost of capital are lower for banks with large deposit holdings. There can be two competing explanations for this finding. Either depositors are willing to accept a too low deposit rate because of deposit insurance or depositors are willing to accept a low deposit rate in exchange for the liquidity provision service that comes from having a demand deposit account in the bank (see e.g. Allen, Carletti, and Marquez (2015) and DeAnglo and Stulz (2015)).

In Table 12 we use Bank Regulatory data to decompose deposits into demand and time deposits. Not all banks report this decomposition and the sample size is therefore smaller than in the basic regressions. In specification (1) to (3), we see that both types of deposits tend to lower the cost of capital, but that demand deposits have a higher coefficient than time deposits. This seems to indicate that there is more competition among rates for time deposits and that depositors are willing to accept a low rate in return for the benefits of having demand deposits in the bank. In specification (4) to (6), we try to further decompose time deposits into insured and non-insured deposits. Having insured deposits did not make a difference before the crisis and only have a minor effect after the crisis. We do see that having larger time deposits (with size above 100k) after the crisis tend to lower the total cost of capital. This effect could be a deposit insurance effect because the deposit insurance limit was increased to 250k after the crisis. We cannot capture the change in amount for insured deposits more precisely because very few banks report, how there time deposits are divided around the 250k threshold.

4 Tax shield loss

The cost of capital results have so far been from the perspective of the investor or the holders of (all) the equity and debt. The analysis thus has 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 (similar to setting Equation (3) and (4) equal to each other):

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

The results from Section 3.3 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 was 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 13 shows regressions 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 18.22% (with the firm tax rate assumption and before the 2008 crisis). This effect is larger during other time periods and with the federal tax assumption making the 18.22% a kind of lower bound. This indicates that the present value of the tax shield decreases significantly when the amount of interest bearing debt is reduced.

The regressions 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 have 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 become weaker after 2011. However, when deposits substitute for other debt with higher interest payments, the present value of the foregone interest payments are 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 differences in capital structure

In this section we investigate the impact of differences in 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. Translating the tax shield loss into an increase in customer borrowing rates is an exercise, which allows us to compare our results to those of, e.g., Kashyap, Stein, and Hanson (2010) and Baker and Wurgler (2015). However, as in their papers the exercise is an extrapolation.

In Table 14, 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 21 bps, the cost of debt capital should decrease by 3 bps, and the total cost of capital should decrease by 1 bps. At the same time the firm value should decrease by up to 60 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 2.40% of total firm value. Looking only at the more recent sample period this number would be around 3.25%.

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 total funding cost will not change, and that the tax shield loss will be 2.25% 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[10] (ignoring the change in expected bankruptcy costs). Table 14 shows that the increase in loan rates for a 10 percentage point increase in the tier 1 ratio would be around 7.9 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 2.5 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).

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

6 Conclusion

We show that the cost of equity and debt capital are lower for banks with higher levels of tier 1 ratios. At the same time, the total cost of capital is not affected by the level of tier 1 capital. These findings provide support for the conservation of risk principle (Modigliani and Miller, 1958). Investors adjust their return expectations as if capital structure is irrelevant. Our conclusion is in contrast to earlier work in this area, which either finds that the equity cost of capital get a partial adjustment (King (2009), Miles, Yang, and Marcheggiano (2013)) or no adjustment at all (Baker and Wurgler (2015)) for higher levels of tier 1 capital.

Compared to earlier studies, we extract the expected cost of equity capital from analyst earnings forecast, we assume that bank debt is not risk free, and we control for the level of asset risk within each bank.

From a welfare perspective it is interesting to know how customer borrowing rates would respond to increased equity funding in banks. When banks charge higher customer borrowing rates, they face less value creating investments, which will hamper the banks' willingsness to provide capital to less profitable customers. Hence, higher capital requirements could have a negative impact on economic activity. 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 extrapolated bank value loss is 1.57% after 2011. This bank value loss could be offset by an increase in customer loan rates of around 2.5 bps. The 2.5 bps is far smaller than that found in earlier studies (see Kashyap, Stein, and Hanson (2010) and Baker and Wurgler (2015)).

A1 Appendix: The implied cost of capital (ICC)

The ICC used in this paper is computed as the equal-weighted 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) show that the implied cost of capital can be expressed as:

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

Where A,

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

and STG,

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

Where EPS_1 and EPS_2 are forecasts of one- and two-year-ahead earnings per share. 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).[11] 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.[12]

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

[11] 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.

[12] 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.

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:

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

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,

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

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:

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

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 empirically estimate how the tax shield is related to the tier 1 ratio in Table 13.

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Table 1: 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	9.11	1.897	7.884	8.84	10.12	46361
r^d	2.591	1.551	1.154	2.566	3.869	144717
r^{total}	3.296	1.421	1.952	3.298	4.412	42691
Tier1 ratio	0.116	0.035	0.092	0.112	0.134	136539
Tier1 ratio (Bank Regulatory)	0.127	0.036	0.103	0.119	0.141	95978
Tier1 to assets ratio	0.091	0.021	0.077	0.088	0.101	95998
Tier2 ratio	0.034	0.038	0.012	0.014	0.044	135649
Tier2 ratio (Bank Regulatory)	0.015	0.008	0.011	0.012	0.015	88248
Tier2 to assets ratio	0.011	0.007	0.007	0.009	0.011	95863
Deposit to assets	0.752	0.101	0.692	0.771	0.828	157971
Equity to assets	0.097	0.035	0.075	0.09	0.11	157870
Equity to RWA	0.128	0.043	0.099	0.121	0.147	95649
CET1 ratio	0.13	0.046	0.104	0.12	0.14	8103
Off-balance to assets ratio	0.001	0.004	0.0	0.0	0.0	88420
New-equity issuance	0.176	0.381	0.0	0.0	0.0	158653
Gov. support	0.013	0.46	0.0	0.0	0.0	158653
RWA to Assets	0.733	0.118	0.658	0.736	0.811	85276
Tax shield to firm value	0.19	0.072	0.134	0.206	0.247	42691

Table 2: 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 3: 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 2.2). 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	(6) r^e
Tier1 ratio	-8.369^{***} (1.56)	-8.537^{***} (1.583)	-8.596^{***} (1.594)	-8.546^{***} (1.597)	-8.559^{***} (1.618)	-7.212^{***} (1.965)
Tier2 ratio		-3.069 (1.872)	-3.264^{*} (1.89)	-3.242^{*} (1.891)	-3.241^{*} (1.902)	-0.761 (3.151)
Deposit to assets			-0.701 (0.694)	-0.742 (0.691)	-0.689 (0.694)	-0.105 (0.764)
Gov. sup.			-0.701 (0.694)			
Gov. sup. dummy1				-0.256 (0.161)		-0.431^{***} (0.161)
Gov. sup. dummy2					-0.09 (0.193)	
Off-balance exposure						38.352^{***} (10.764)
Observations	42710	42587	42587	42587	42587	30609
R-squared	0.665	0.666	0.666	0.666	0.666	0.604
Bank FE	y	y	y	y	y	y
Month FE	y	y	y	y	y	y

Table 4: 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 2.3). Specification (1) to (5) is restricted to the banks covered by analyst forecasts, whereas specification (6) is for all banks. 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
Tier1 ratio	-1.713^{***}	-1.728^{***}	-1.702^{***}	-1.68^{***}	-1.901^{***}	-1.588^{***}
	(0.546)	(0.549)	(0.544)	(0.546)	(0.611)	(0.29)
Tier2 ratio	1.025	1.015	1.031	1.044	0.175	0.635^{**}
	(0.663)	(0.664)	(0.662)	(0.664)	(0.795)	(0.302)
Deposit to assets	-0.627^{***}	-0.615^{**}	-0.637^{***}	-0.629^{***}	-0.395	-1.378^{***}
	(0.243)	(0.242)	(0.242)	(0.243)	(0.304)	(0.144)
Gov. sup.		0.293^{***}				
		(0.113)				
Gov. sup. dummy1			-0.042		-0.062	-0.045
			(0.062)		(0.056)	(0.043)
Gov. sup. dummy2				-0.047		
				(0.064)		
Off-balance exposure					-18.096^{***}	
					(5.391)	
Observations	39264	39264	39264	39264	28424	124554
R-squared	0.966	0.966	0.966	0.966	0.961	0.958
Bank FE	y	y	y	y	y	y
Month FE	y	y	y	y	y	y

Table 5: 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 2.4). 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}	(6) r^{total}
Tier1 ratio	-0.519	-0.451	-0.529	-0.489	-0.46	-0.39
	(0.509)	(0.506)	(0.497)	(0.491)	(0.482)	(0.587)
Tier2 ratio		1.161*	0.912	0.935	0.951	0.633
		(0.639)	(0.602)	(0.596)	(0.605)	(0.847)
Deposit to assets			−0.724***	−0.76***	−0.733***	−0.515*
			(0.217)	(0.217)	(0.218)	(0.265)
Gov. sup.			−0.724***			
			(0.217)			
Gov. sup. dummy1				−0.132**		−0.171***
				(0.064)		(0.055)
Gov. sup. dummy2					-0.091	
					(0.056)	
Off-balance exposure						−14.569***
						(4.399)
Observations	39381	39264	39264	39264	39264	28424
R-squared	0.961	0.962	0.962	0.962	0.962	0.959
Bank FE	y	y	y	y	y	y
Month FE	y	y	y	y	y	y

Table 6: 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 without off-balance sheet liability exposure, whereas the reduced sample in specification (4) to (6) includes this exposure. Deposits to assets is the book value of deposits to book value of asset. Government support dummy1 is equal to 1 in the years where the government had an equity stake in the bank and 0 otherwise. 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^{e}	(3) r^{d}	(4) r^{total}	(5) r^{e}	(6) r^{d}
Tier1 ratio	-1.009	-10.032^{***}	-1.803^{**}	-1.324	-8.771^{***}	-1.968^{**}
	(0.716)	(2.131)	(0.825)	(0.809)	(2.465)	(0.945)
Tier2 ratio	0.655	-4.02^{**}	0.629	-0.405	-2.297	-0.415
	(0.672)	(1.952)	(0.697)	(0.94)	(3.094)	(0.885)
Deposit to assets	-0.677^{***}	-0.518	-0.651^{***}	-0.432^{*}	0.109	-0.395
	(0.217)	(0.695)	(0.247)	(0.257)	(0.759)	(0.304)
Deposit to assets x Large	-0.155	-0.883^{*}	0.035	-0.183	-1.169^{*}	0.093
	(0.141)	(0.521)	(0.15)	(0.166)	(0.635)	(0.167)
Deposit to assets x Small	-0.254	-0.043	-0.011	-0.224	0.275	-0.101
	(0.175)	(0.489)	(0.166)	(0.191)	(0.795)	(0.184)
Tier1 ratio x Large	0.731	4.708	-0.323	0.801	5.256	-0.627
	(0.83)	(2.955)	(0.862)	(0.944)	(3.567)	(0.971)
Tier1 ratio x Small	1.655	0.102	-0.113	1.735	-0.521	1.301
	(1.369)	(3.781)	(1.264)	(1.564)	(5.999)	(1.37)
Tier2 ratio x Large	0.761	0.112	1.128	3.474^{*}	5.389	2.43
	(0.724)	(2.285)	(0.716)	(2.039)	(3.745)	(1.831)
Tier2 ratio x Small	0.51	1.996	0.159	0.225	-3.837	-0.568
	(0.888)	(2.555)	(0.961)	(1.277)	(3.981)	(1.275)
Gov. Sup. Dummy1	-0.128^{**}	-0.245	-0.042	-0.166^{***}	-0.401^{**}	-0.062
	(0.064)	(0.159)	(0.062)	(0.055)	(0.158)	(0.056)
Off-balance exposure				-14.813^{***}	38.774^{***}	-18.373^{***}
				(4.327)	(10.683)	(5.409)
Observations	39264	42587	39264	28424	30609	28424
R-squared	0.962	0.667	0.966	0.959	0.606	0.962
Bank FE	y	y	y	y	y	y
Month FE	y	y	y	y	y	y

Table 7: 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 dummy1 is equal to 1 in the years where the government had an equity stake in the bank and 0 otherwise. 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	−1.306**	−0.967*	−7.608***	−8.251***	−2.036***	−1.989***
	(0.609)	(0.568)	(2.053)	(1.813)	(0.666)	(0.625)
Tier2 ratio	1.058	1.324*	-1.296	-1.698	0.953	1.224
	(0.831)	(0.729)	(2.342)	(2.118)	(0.82)	(0.757)
Deposit to assets	−0.802***	−0.758***	-0.128	-0.468	−0.722***	−0.647***
	(0.233)	(0.223)	(0.79)	(0.711)	(0.243)	(0.242)
Gov. Sup. Dummy1	−0.145**	−0.14**	-0.195	-0.225	-0.054	-0.048
	(0.06)	(0.06)	(0.154)	(0.156)	(0.06)	(0.06)
Deposit to assets I ($\geq$ 2008)	0.361		−3.098***		0.468	
	(0.27)		(1.041)		(0.315)	
Tier1 ratio I ($\geq$ 2008)	2.224***		-4.276		1.028	
	(0.817)		(3.592)		(0.845)	
Tier2 ratio I ($\geq$ 2008)	-0.211		−6.826*		0.207	
	(1.449)		(3.835)		(1.195)	
Deposit to assets I ($\geq$ 2011)		0.382		−2.392**		0.332
		(0.299)		(1.012)		(0.393)
Tier1 ratio I ($\geq$ 2011)		1.557*		-2.925		0.994
		(0.822)		(2.799)		(0.881)
Tier2 ratio I ($\geq$ 2011)		-1.357		−6.358**		-0.686
		(0.853)		(2.946)		(0.798)
Observations	39264	39264	42587	42587	39264	39264
R-squared	0.963	0.963	0.669	0.668	0.966	0.966
Bank FE	y	y	y	y	y	y
Month FE	y	y	y	y	y	y

Table 8: Various Other Capital Ratios

This table presents estimated coefficients for various regressions with different choices of how to measure bank leverage. The regressions mimic those in Table 3 to 5 except that the tier 1 ratio has been replaced with tier 1 capital to assets, common equity to RWA, or common equity to total 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}
Deposit to assets	−0.507**	−0.477*	−0.888***	-0.039	-0.061	−1.147*	-0.342	-0.395	−0.907***
	(0.244)	(0.248)	(0.217)	(0.737)	(0.722)	(0.659)	(0.282)	(0.286)	(0.228)
Gov. Sup. Dummy1	−0.152**	−0.15**	−0.144**	−0.348**	−0.423**	-0.271	-0.035	-0.059	-0.068
	(0.062)	(0.062)	(0.065)	(0.157)	(0.167)	(0.171)	(0.063)	(0.067)	(0.063)
Tier1 to assets ratio	-0.33			−12.606***			−4.058***		
	(0.89)			(2.317)			(0.997)		
Equity to RWA		0.604			-2.859			−1.923***	
		(0.483)			(1.738)			(0.479)	
Equity to Assets			1.38**			−8.562***			−3.26***
			(0.652)			(1.945)			(0.721)
Observations	32652	32673	42686	34969	34990	46355	32652	32673	42686
R-squared	0.96	0.96	0.958	0.629	0.624	0.663	0.963	0.962	0.964
Bank FE	y	y	y	y	y	y	y	y	y
Month FE	y	y	y	y	y	y	y	y	y

Table 9: CET1 ratio and CET1 buffer size

This table presents estimated coefficients for various regressions with cost of capital as the dependent variable. The regressions mimic those in Table 3 to 5 except that the tier 1 ratio has been replaced with the CET1 ratio or the CET1 buffer size, which is the distance between the CET1 ratio and the capital requirement. 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	0.885	-9.167^{*}	-0.813^{**}			
	(1.167)	(4.852)	(0.335)			
Deposit to assets	0.116	0.255	-0.163	0.149	0.312	-0.169
	(0.382)	(2.425)	(0.265)	(0.381)	(2.45)	(0.269)
CET1 buffer				0.91	-9.124^{*}	-0.818^{**}
				(1.163)	(4.852)	(0.335)
Observations	2169	2252	2169	2160	2240	2160
R-squared	0.917	0.874	0.917	0.917	0.874	0.917
Bank FE	y	y	y	y	y	y
Month FE	y	y	y	y	y	y

Table 10: Regressions without Bank Fixed Effects

This table presents estimated coefficients for various regressions with asset risk substituting the bank fixed effects. The regressions mimic those in Table 3 to 5. Asset risk is measured as risk weighted assets to total 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^{e}	(4) r^{e}	(5) r^{d}	(6) r^{d}
Tier1 to assets ratio	1.979	1.544	−6.428***	−6.121***	-0.744	-1.238
	(1.44)	(1.418)	(1.82)	(1.804)	(1.094)	(1.068)
Tier2 to assets ratio	0.163	0.705	0.089	-0.116	-1.348	-0.731
	(2.064)	(2.051)	(2.551)	(2.562)	(1.605)	(1.534)
Deposit to assets	−1.562***	−2.215***	-0.832	-0.417	−1.647***	−2.413***
	(0.318)	(0.304)	(0.61)	(0.566)	(0.324)	(0.318)
RWA to Assets	1.054***	1.022***	1.339***	1.319***	0.526*	0.485*
	(0.324)	(0.302)	(0.396)	(0.404)	(0.29)	(0.261)
Gov. Sup. Dummy1	-0.045	−0.069*	-0.025	-0.039	0.096**	0.069*
	(0.044)	(0.041)	(0.193)	(0.185)	(0.046)	(0.041)
Off-balance exposure		−21.192***		14.41*		−24.537***
		(2.851)		(8.297)		(3.079)
Observations	27634	27442	29614	29408	27634	27442
R-squared	0.863	0.871	0.294	0.295	0.844	0.854
Bank FE	y	y	y	y	y	y
Month FE	n	n	n	n	n	n

Table 11: Equity Issuance

This table presents estimated coefficients for various regressions with cost of capital as the independent variable (in percentage points). Specification (1) to (3) is with quarterly observations and specification (4) to (6) is with monthly observations. The indicators for issuance is 1 in the fiscal quarter where the bank did an equity issuance and 0 otherwise. The repurchase is 1 in the fiscal quarters where the bank did a equity repurchase. The increment in capital requirement is 1 when the bank reports an increase in capital requirements and 0 otherwise. The indicator is positions according to the timing of the increase in requirements. Hence, the indicator is only 1 in the months indicated in the table, i.e., before (0-6 months), immediately after (0-6 months), sometime after (6-12 month). Otherwise the regressions mimic those in Table 3 to 5. 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
Tier1 ratio	-0.413	-8.361^{***}	-1.679^{***}	-0.488	-8.543^{***}	-1.701^{***}
	(0.507)	(1.638)	(0.544)	(0.491)	(1.596)	(0.544)
Tier2 ratio	0.791	-3.506^{*}	0.971	0.937	-3.237^{*}	1.033
	(0.599)	(1.917)	(0.636)	(0.596)	(1.89)	(0.661)
Deposit to assets	-0.743^{***}	-0.739	-0.628^{***}	-0.761^{***}	-0.745	-0.638^{***}
	(0.217)	(0.723)	(0.24)	(0.217)	(0.691)	(0.242)
Gov. sup. dummy1	-0.145^{**}	-0.296^{*}	-0.051	-0.131^{**}	-0.255	-0.041
	(0.066)	(0.168)	(0.063)	(0.064)	(0.161)	(0.062)
New Equity Issuance Dummy	-0.074	-0.028	-0.118	-0.007	-0.023	-0.006
	(0.141)	(0.258)	(0.131)	(0.005)	(0.017)	(0.006)
New Equity Repurchases Dummy	-0.087	-0.04	-0.136	0.003	0.015	-0.003
	(0.141)	(0.262)	(0.131)	(0.008)	(0.032)	(0.01)
0-6 months before increment in req. capital dummy	0.064	0.074	0.2^{***}			
	(0.043)	(0.162)	(0.062)			
0-6 months after increment in req. capital dummy	0.078^{**}	0.122	0.213^{***}			
	(0.037)	(0.177)	(0.061)			
6-12 months after increment in req. capital dummy	0.018	-0.066	0.175^{***}			
	(0.035)	(0.148)	(0.042)			
Issuance Dummy 0-6 x 0-6 months before dummy	-0.016	0.14	-0.1			
	(0.051)	(0.161)	(0.068)			
Issuance Dummy 0-6 x 0-6 months after dummy	-0.039	0.101	-0.12			
	(0.062)	(0.194)	(0.081)			
Issuance Dummy 0-6 x 6-12 months after dummy	0.068	0.118	-0.061			
	(0.053)	(0.223)	(0.061)			
Observations	13213	14362	13213	39264	42587	39264
R-squared	0.963	0.671	0.967	0.962	0.666	0.966
Bank FE	y	y	y	y	y	y
Month FE	y	y	y	y	y	y

Table 12: Decomposing the deposit ratio

This table presents estimated coefficients for various regressions with the cost of capital as the dependent variable (in percentage points). The setup mimic those in Table 3 to 5. This table splits up deposits into demand deposits and term deposits. Furthermore, it also splits up term deposits based on their size. The regressions are calculated with cluster robust standard errors over bank and year. The regressions are with bank and year fixed effects.

Variables	(1) r^{total}	(2) r^{e}	(3) r^{d}	(4) r^{total}	(5) r^{e}	(6) r^{d}
Tier1 ratio	-0.501 (0.553)	-6.511^{***} (1.729)	-1.984^{***} (0.561)	-0.094 (0.54)	-5.869^{***} (1.698)	-1.489^{***} (0.527)
Tier2 ratio	0.654 (0.711)	-1.329 (2.608)	0.07 (0.647)	0.886 (0.708)	-0.407 (2.655)	0.721 (0.692)
Gov. sup. dummy1	-0.145^{**} (0.065)	-0.379^{**} (0.158)	-0.039 (0.069)	-0.125^{**} (0.055)	-0.355^{**} (0.16)	0.003 (0.052)
Demand deposits	-1.137^{***} (0.28)	0.03 (0.947)	-1.205^{***} (0.325)			
Non-demand deposits	-0.596^{**} (0.244)	-0.145 (0.702)	-0.467^{*} (0.271)			
Time deposits $<$ 100k to Assets $<$ oct. 2008				-0.025 (0.306)	0.504 (0.997)	0.599^{*} (0.342)
Time deposits $<$ 100k to Assets $\geq$ oct. 2008				-0.706 (0.435)	1.417 (1.451)	-0.632 (0.475)
Time deposits $>$ 100k to Assets $<$ oct. 2008				0.225 (0.383)	0.297 (0.936)	0.887^{**} (0.426)
Time deposits $>$ 100k to Assets $\geq$ oct. 2008				-0.917^{**} (0.414)	-3.119^{**} (1.259)	-0.593 (0.467)
All other deposits to Assets				-1.133^{***} (0.251)	-1.106 (0.692)	-1.282^{***} (0.277)
Observations	33869	36353	33869	32662	35071	32662
R-squared	0.961	0.654	0.963	0.962	0.651	0.966
Bank FE	y	y	y	y	y	y
Month FE	y	y	y	y	y	y

Table 13: 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 labelled Federal the tax shield is calculated assuming a federal tax rate. In the other columns the tax shield is calculated using a company specific average tax rate derived from last years tax payments. The explanatory variables are the same as in Table 7. 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	-18.63^{***}	-24.033^{***}	-18.233^{**}	-25.615^{***}
	(4.842)	(4.428)	(8.762)	(8.402)
Tier2 ratio	-11.678^{**}	-10.469^{*}	5.022	5.664
	(5.673)	(5.566)	(15.108)	(14.885)
Deposit to assets	-1.539	-1.544	3.773	3.467
	(1.684)	(1.564)	(2.338)	(2.234)
Gov. Sup. Dummy1	1.751^{***}	1.763^{***}	2.623^{***}	2.632^{***}
	(0.528)	(0.523)	(0.812)	(0.806)
Deposit to assets I ($\geq$ 2008)	-7.783^{**}		-9.817^{***}	
	(3.061)		(3.457)	
Tier1 ratio I ($\geq$ 2008)	-18.513^{**}		-12.227	
	(7.448)		(11.313)	
Deposit to assets I ($\geq$ 2011)		-15.216^{***}		-17.049^{***}
		(3.329)		(3.386)
Tier1 ratio I ($\geq$ 2011)		-8.454		4.839
		(6.372)		(10.465)
Observations	39264	39264	34429	34429
R-squared	0.921	0.923	0.808	0.809
Bank FE	y	y	y	y
Month FE	y	y	y	y

Table 14: 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 3 (specification (4)), 4 (specification (3)), 5 (specification (4)), and 13 (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 7. 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%	-0.21	-0.04	-0.01	-0.60	1.98
ΔTier1 ratio = 10%	-0.85	-0.17	-0.05	-2.40	7.92
ΔTier1 ratio = -ΔDep ratio = 2.5%	-0.20	-0.03	0.01	-0.56	1.85
ΔTier1 ratio = -ΔDep ratio = 10%	-0.78	-0.11	0.03	-2.25	7.41

Panel B: After 2011	Δr^e	Δr^d	Δr^{Total}	Δ TaxShield	Δ Loan rate (bps)
ΔTier1 ratio = 2.5%	-0.28	-0.02	0.01	-0.81	1.30
ΔTier1 ratio = 10%	-1.12	-0.10	0.06	-3.25	5.20
ΔTier1 ratio = -ΔDep ratio = 2.5%	-0.21	-0.02	0.02	-0.39	0.63
ΔTier1 ratio = -ΔDep ratio = 10%	-0.81	-0.07	0.10	-1.57	2.52

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.

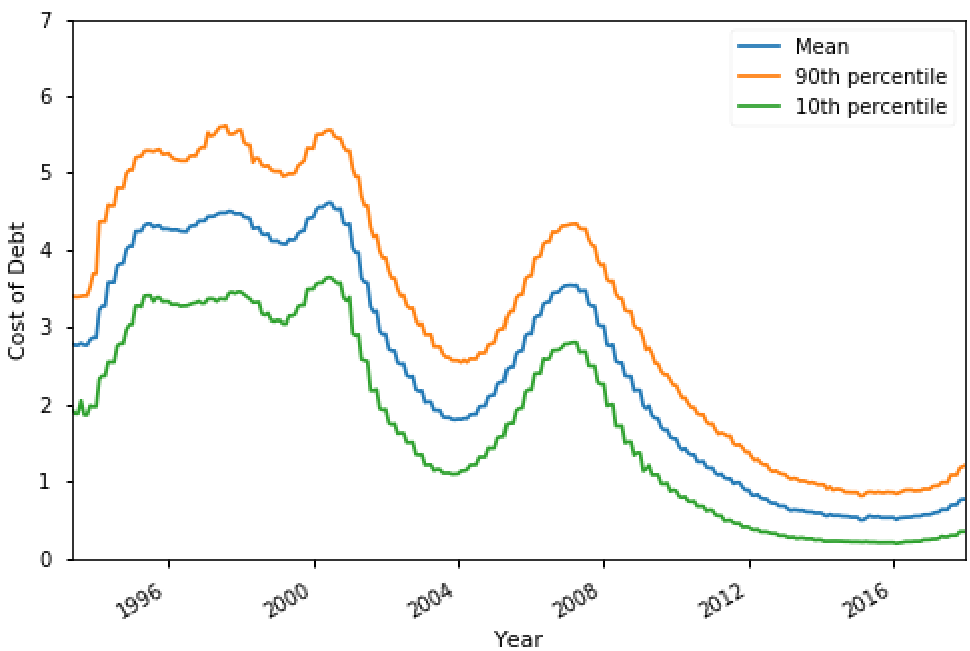


Figure 3: The capital structure of banks

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.

(a) Deposits to Assets

(b) Equity to Assets

(c) Tier1 capital to RWA

(d) Tier2 capital to RWA

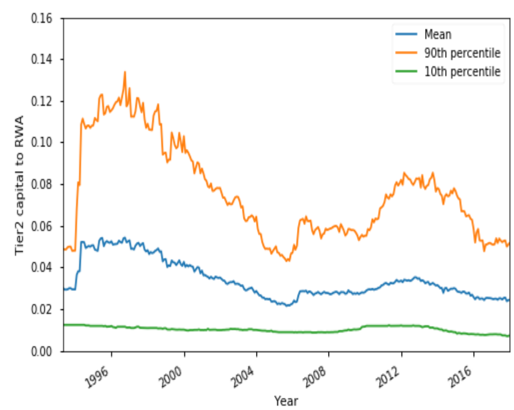


Figure 4: The total cost of capital for banks

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.

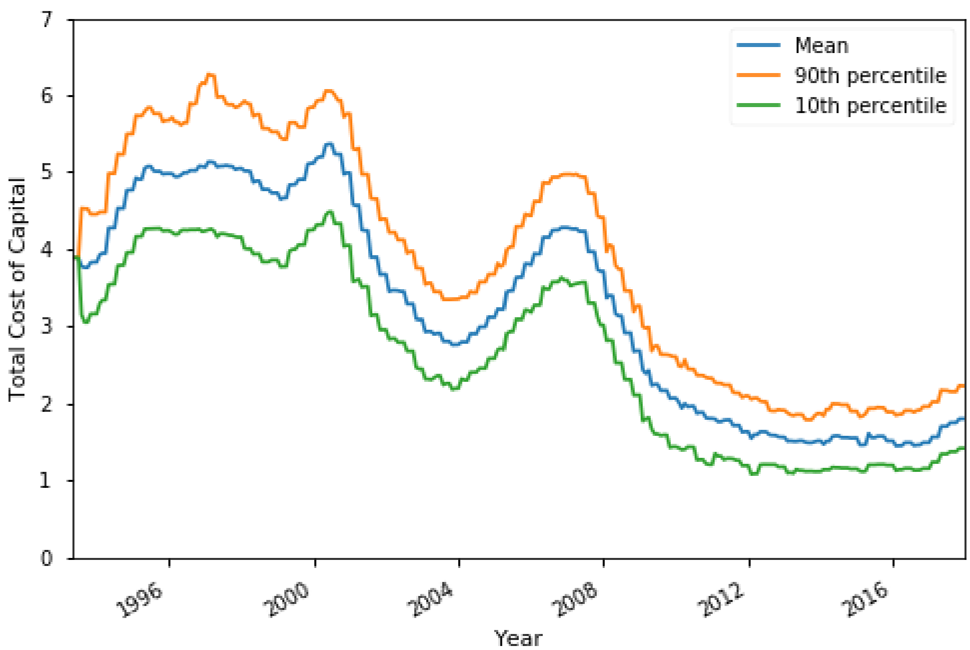
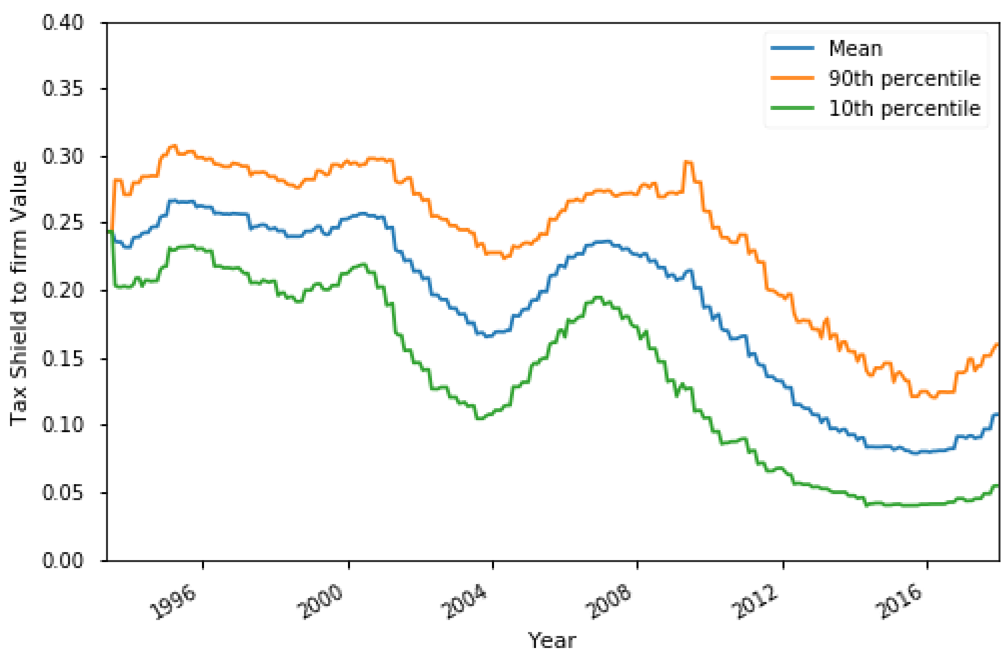


Figure 5: The tax shield ratio for banks

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.



Internet Appendix:
The Cost of Capital for Banks

Table A1: 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	XINTQ
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	RCFDA274
Tier 2 Capital	Bank Regulatory and Hand-Collected	RCFDA275
Equity Capital	Bank Regulatory and Hand-Collected	RCFDA275
Off-balance sheet exposure	Bank Regulatory and Hand-Collected	RCFDA210
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 A2: Macroeconomic state variables

This table presents estimated coefficients for various regressions with equity to assets as the independent variable. The regressions mimic those in Table 3 to 5 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}
Tier1 ratio	−0.803*	−4.161***	−1.13**
	(0.448)	(1.599)	(0.541)
Tier2 ratio	1.9***	-1.623	2.375***
	(0.608)	(1.927)	(0.703)
Deposit to assets	−1.047***	0.906	−0.774***
	(0.201)	(0.686)	(0.247)
Gov. sup. dummy1	−0.201***	0.016	0.059
	(0.052)	(0.156)	(0.049)
Macro dp	0.047	0.919***	0.263***
	(0.06)	(0.189)	(0.068)
Macro ep	0.045**	0.72***	0.107***
	(0.019)	(0.098)	(0.02)
Macro bm	−1.946***	−3.235***	−2.608***
	(0.184)	(0.561)	(0.2)
Macro ntis	2.027***	-1.355	2.124***
	(0.46)	(1.587)	(0.494)
Macro tbl	66.088***	49.325***	68.301***
	(1.136)	(3.089)	(1.265)
Macro tms	24.49***	53.922***	21.872***
	(1.129)	(3.185)	(1.218)
Macro dfy	36.206***	93.787***	42.603***
	(1.892)	(7.707)	(1.836)
Macro svar	4.188***	-4.744	5.459***
	(0.66)	(3.06)	(0.705)
Observations	39264	42587	39264
R-squared	0.951	0.509	0.952
Bank FE	y	y	y
Month FE	n	n	n

Table A3: 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.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1.Leverage Buffer Well	1.0							
2.Leverage Buffer	0.983	1.0						
3.Total Risk Capital Buffer Well	-0.029	-0.034	1.0					
4.Total Risk Capital Buffer	-0.029	-0.034	0.999	1.0				
5.CET1 Buffer Well	0.715	0.708	0.018	0.018	1.0			
6.CET1 Buffer	0.718	0.715	0.02	0.02	0.996	1.0		
7.Tier1 ratio Buffer Well	0.561	0.572	-0.013	-0.013	0.649	0.653	1.0	
8.Tier1 ratio Buffer	0.551	0.572	-0.011	-0.011	0.645	0.656	0.992	1.0